

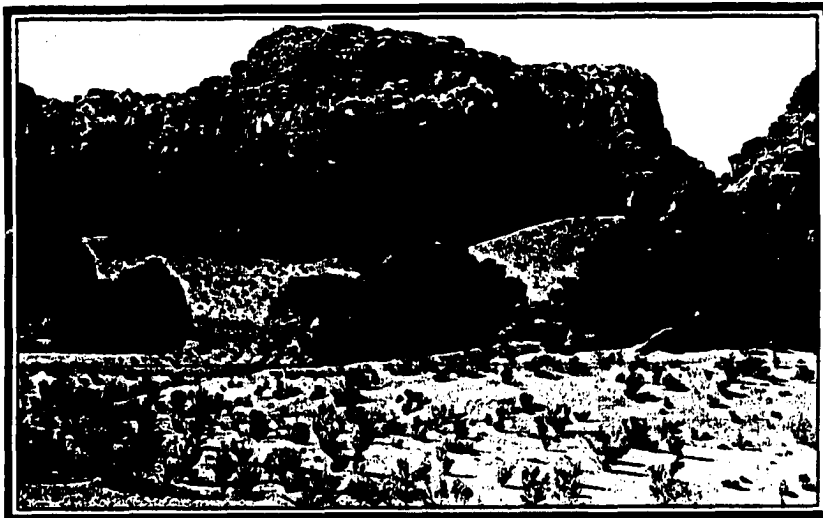
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The Hashemite Kingdom of Jordan

NATIONAL ENVIRONMENT STRATEGY FOR JORDAN

A Resource Book of Information
and Guidelines for Action



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Ministry of Municipal and Rural Affairs & the Environment
Department of Environment

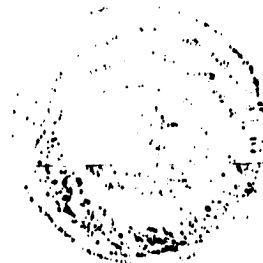


IUCN – The World Conservation Union

“The conservation of the environment is not a luxury but a national and human duty because of its direct connection with humanity’s livelihood, progress, and even survival. Therefore, we must accord it the priority it deserves in all state activities and make it one of the components of our national culture.”

– His Majesty King Hussein

(Letter of Designation to Prime Minister Taher Masri, June 19, 1991)



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A Resource Book of Information
and Guidelines for Action

(Translated from Arabic)

The NES Project was co-sponsored by
The Hashemite Kingdom of Jordan, and the
U. S. Agency for International Development

Technical advice was provided by the
International Union for Conservation of Nature
Gland, SWITZERLAND

Compiled by John D. McEachern
IUCN Project Manager

August 1991



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This document has been translated from Arabic, and represents a compilation of work prepared by many Jordanian experts who participated in the ten resource-sector working groups of the National Environment Strategy (NES). We have endeavoured to accurately reflect this Jordanian Strategy by retaining the manner of expression, as well as the substance of the issues raised and actions recommended. Although this strategy is broadly supported by IUCN, specific statements or recommendations may not necessarily represent the policies or opinions of IUCN.

NES Project Secretariat, Amman, JORDAN

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Foreword

By Her Majesty Queen Noor Al Hussein



Amman
July 1991

When we launched the Jordan National Environment Strategy Project in January 1989, followed by the first national environmental workshop held in Amman, the combined aim of the Jordanian government and the IUCN was to compile a document that accurately reflected the special characteristics of the total environment of Jordan and the measures required to safeguard and preserve our environment for future generations. I am pleased to see that the two and a half years of work since then by ten working groups of Jordanian experts has resulted in this comprehensive and very impressive document.

We are proud that Jordan is the first country in the Middle East to have completed such a national environmental strategy. I hope that this resource book will serve as a model for integrated environmental protection strategies in other countries of the Middle East and the developing world, and I am certain that Jordanian expertise will always be made available, if required, to assist others in drawing up their own national strategies. We now look forward to meeting the challenges of the next phase of environmental protection efforts by working closely with others in the Middle East to formulate regional strategies, which are essential for effective protection and conservation efforts.

This National Environment Strategy document and the effort that went into producing it clearly reflect principles which we value and adhere to in our approach to environmental protection. The first is close co-operation among many different economic and administrative sectors, based on the recognition that environmental protection is not the sole concern of a single ministry or government department. By including chapters on the people, their settlements, and the antiquities of our land, this book attests to our view of the environment in its broadest physical, human and temporal contexts. Perhaps as useful as the document itself has been the process of drawing up this strategy through sustained and focused co-operation among scores of people from the public and private sectors, universities, NGOs, research institutions and international organizations, who worked together closely to achieve an overriding national objective.

The second principle is international co-operation with our friends and partners in environmental protection around the world, exemplified by the close and valuable technical assistance we have enjoyed from the IUCN. We particularly appreciate the fine work of Jordan Environment Strategy Project Manager John McEachern, the technical assistance provided by the IUCN, and the financial support of USAID. I believe that our close links with IUCN, including my own role as IUCN Patron, accurately reflect our commitment to meaningful international co-operation as a vital element in effective, long-term and global environmental protection efforts.

We recognise that primary responsibility for environmental protection in Jordan falls on the shoulders of the people and government of Jordan. In this respect, we would like to thank the over 180 Jordanians whose hard work and technical expertise have produced this environmental strategy. Their considerable knowledge and sensitivity reflect our indigenous ability to delineate and address our many environmental protection challenges. They have served their country and their planet well, and for that they have the thanks and appreciation of all the people of Jordan.

This Jordan environmental strategy resource book is a technical document, but it is also much more than that. It is another indication of our commitment to the land, to our identity, to our national heritage and to our responsibility as members of a global community of human beings who share a single planet. It is our pledge to maintain environmental protection as a national priority, to preserve our earth, wind and water as a symbol of the bond between the legacy of our ancestors, our contemporary responsibilities and capabilities, and the promise of our future generations.

الأمير

Acknowledgements



At the policy level, the project was overseen by a Steering Committee, which was chaired by the Honourable Minister of the Ministry of Municipal and Rural Affairs & the Environment (MMRA&E). Many distinguished Jordanians served on the Committee, representing a full range of environmental and development interests. The Committee met seven times during the project and guided and supported the work of the Project Secretariat.

Chairmen of the NES Steering Committee

(The Ministers of MMRA&E are listed in order of their appointments)

- H.E. Marwan Hmoud
- H.E. Dr. Mohammad Al Zabin
- H.E. Yousef Hamdan Al Jaber
- H.E. Salim Al Zoubi (*In Office*)
- H.E. Abdul Karim Ad Dughmi

Members of the NES Steering Committee

(*Denotes members who also served as Chairman of a Working Group)

- H.E. Abd Arrauf Rawabdeh
- Dr. Adnan Abbas
- H.E. Anis Mouasher*
- Mr. Nasri Atalla*
- H.E. Ali Dajani
- Dr. Abdullah Toukan*
- Dr. Eng. Mohammad Bani Hani
- Dr. Munzer Al Masri
- Eng. Awad K. Tell
- Dr. Mutazz Belibeisi*
- Dr. Eng. Sami Sunna*
- Eng. Yousef Hiasat*
- Mr. Bassam Kakish*
- Dr. Hani Mulki
- Dr. Safwan Toukan
- Dr. Rashad M. Natour
- Dr. Eng. Ibrahim Badran*
- Dr. Safwan Saket
- Eng. Asem Ghousheh*
- Dr. Mohammad Subbarini
- Dr. Hani Al Amad
- Dr. Sufyan Tell
- Mr. Trad El Fayez*
- Dr. Saleh Share'
- Dr. Saleh Khasawneh

Alternate Members of the NES Steering Committee

- Dr. Ghazi Bisheh
- Eng. Bassam Sunna
- Dr. Ali Abandah
- Eng. Mohammad Shahbaz
- Dr. Murad J. Bino
- Dr. Dureid Mahasneh
- Dr. Ghassan Abu 'Amara
- Dr. Sa'ed Kharabsheh
- Dr. Husein Zaki

Non-Voting Members and Observers

- Mr. Ma'moun Salah
- Mr. Abdullah Ahmad
- Mr. Suleiman Hanbali
- Mr. John McEachern

Members of the NES Secretariat

- | | |
|--|---|
| • Dr. Eng. Moh. Bani Hani
(<i>Current NES Project Director</i>) | Director of the Strategy (1990-1991)
Secretary General, MMRA&E |
| • Dr. Eng. Sufyan Tell
(<i>Former NES Project Director</i>) | Director of the Strategy (1989-1990)
Past Director, Dept. of Environment |
| • Mr. Suleiman Hanbali | Assistant Director, NES |
| • Mrs. Khawla Fayyad | Professional Translator, NES |
| • Mrs. Hwaida Madi | Executive Secretary, NES |
| • Mr. John McEachern | IUCN Project Manager |

The principal contributors to the NES have been Jordanian technical experts, drawn from government, industry and the academic community. More than 180 individuals gave their time and expertise to a number of working groups which were created along sectoral lines. The names of these persons appear at the end of each sector chapter and their essential contribution to the preparation of the NES is gratefully acknowledged.

Throughout the duration of the project, each working group was ably chaired by a distinguished Jordanian, drawn from the Steering Committee. These chairmen have long practical experience in resource planning, administration and management, and their services are gratefully acknowledged.

ACKNOWLEDGEMENT FROM IUCN

IUCN gratefully acknowledges the support and unflagging assistance provided to the project by Dr. Eng. Moh. Bani Hani, the current NES Project Director and Secretary General of the MMRA&E, and to Dr. Eng. Sufyan Tell, the former Director. In addition, the assistance of Mr. Abdullah Ahmad of USAID is recognized. Together, these men facilitated the project in countless ways—often behind the scene—and were instrumental in bringing the project to successful completion.

Finally, the Jordanian staff of the Secretariat have been first rate. IUCN commends their day-to-day efforts, their personal commitment to the project, and overall professionalism: Mr. Suleiman Hanbali, Assistant Director NES; Mrs. Khawla Fayyad, Professional Translator; and Mrs. Hwaida Madi, the Executive Secretary. The project driver and expeditor, Mr. Khalaf Suleiman, also provided excellent support. Working with them has been a great pleasure.

— John McEachern
IUCN Project Manager

Background

THE STEPS TO STRATEGY PREPARATION

Jordan holds the distinction of being among the original group of 30 countries to declare support for the World Conservation Strategy (WCS) in March, 1980. This declaration encouraged each country to prepare a national strategy for environmental protection to address that country's specific problems, using as a guide the WCS framework. Accordingly, when the Department of Environment was established in 1980, one of its first tasks was to initiate planning for a national strategy.

In 1982, the National Environment Commission was formed under the honorary chairmanship of HM Queen Noor and on February 2nd, 1985, the prime minister convened a committee including members of various ministries and official agencies, to prepare an environmental protection strategy for Jordan. One of the outcomes of this committee's efforts was to treat the environment as a separate sector in the five-year development plan (1986-1990).

In June 1988, the Council of Ministers agreed in its decision No. 7951 to form a steering committee, under the chairmanship of the minister of Municipal, Rural Affairs & the Environment, to initiate the strategy process. This committee was charged with the task of drawing up environmental policies, facilitating and reviewing the progress of work, and consulting with the various sectors involved in environmental affairs. On September 9th, 1988—following upon the prime minister's letter of authorization of June 20th, 1988 (No. 7440)—an agreement for producing the strategy was signed between the government of the Hashemite Kingdom of Jordan, represented by the Ministry of Municipal and Rural Affairs & the Environment, and the International Union for the Conservation of Nature and Natural Resources (IUCN).

The United States Agency for International Development agreed to fund this project and called on IUCN to provide technical assistance to the Jordanian government to prepare a strategy within the framework of the WCS.

Finally, the Strategy was officially approved by the Government of Jordan on May 2, 1991 at the 7th Steering Committee Meeting, under the chairmanship of H.E. Dr. Mohammad Al Zabin, Minister of Municipal and Rural Affairs and the Environment.

A NOTE ON IMPLEMENTATION

A strategy is useless if it is not implemented. The long-term success of Jordan's strategy will hinge upon the combined efforts of government, NGOs, private sector businesses, communities, and individuals putting into practice the various actions which have been recommended.

The National Environment Strategy for Jordan is intended to be more than a set of guidelines and principles. By intert, the strategy generated substantial information on Jordan's natural and socio-economic environment, as well as the names and affiliations of Jordanian experts and written source material. This information has been retained in this document in response to the wishes of the project working groups and the steering committee. Furthermore, planners can draw upon this *Resource Book of Information* to prepare programmes and projects for implementation.

"SUSTAINABILITY" – A WORKING DEFINITION¹

This strategy employs the terms *sustainability*, *sustainable use*, and *sustainable development*, and it is important for an understanding of the strategy to know how they are used.

Sustainability is a characteristic of a process or a state that can be maintained indefinitely.

Sustainable use is applicable only to renewable resources; it means using them at rates within their capacity for renewal.

Sustainable development is used in this strategy to mean: development which increasingly meets human needs, without depleting the matter and energy of the ecosystem upon which development is founded. An economy which develops sustainably would be designed to perform at a level which would allow the underlying ecosystem to function and renew itself ceaselessly.

Thus, the practical objective of the National Environment Strategy is to ensure that future generations of Jordanians are not burdened with the environmental debt of today's actions—a legacy of depleted resources, environmental problems and attendant decline in living standards.

RESOLUTIONS & RECOMMENDATIONS FROM THE 18TH SESSION OF THE GENERAL ASSEMBLY OF IUCN-THE WORLD CONSERVATION UNION

Sustainable Development (from Resolution 18.14)

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

1. CALS upon governments, especially State members of IUCN to:-
 - a. reduce to the absolute minimum extraction of those non-renewable resources that cannot be substituted, in preparation for the inevitable phasing-out of such extraction in the long term;
 - b. recycle as much as possible of such materials, aiming towards full recycling in the future;
 - c. minimize, and as far as possible eliminate, releases to the biosphere of:-
 - i. oil and petroleum products (through spillages and discharges);
 - ii. gases resulting from combustion of fossil fuels (coal, oil and gas);
 - iii. heavy metals;
 - iv. nitrates and phosphates (resulting from excessive use of fertilizers and from unsustainable intensive agriculture);
 - d. ensure that uses of renewable resources are as efficient as possible and that where renewable resources are being used unsustainably, their use be reduced to sustainable levels;
 - e. recycle all possible organic wastes, thereby reducing pollution of rivers and underground aquifers and enhancing land fertility;
 - f. promote clean and safe renewable energy supplies (such as solar, wind and hydro) thereby minimizing the use of fossil fuels and other sources of pollution;
 - g. promote the development and introduction of technologies and industrial processes that do not discharge waste into rivers, underground aquifers, the sea or the atmosphere;

¹IUCN-UNEP-WWF. (1991). *Caring for the Earth, a Strategy for Sustainable Living*. Gland, Switzerland and Nairobi, Kenya.

h. encourage manufacturers of future consumer goods to plan materially and financially for the full recycling of the materials these goods contain at the end of their useful life.

2. URGES governments, in planning the development of rural and urban societies, to recognize the need for such societies to follow different paths:

a. basing rural development on the conservation, proper management and sustainable use of renewable natural resources;

b. basing urban development on the economical use of materials and energy and on maximal recycling and avoidance of waste.

Ecologically Sustainable Development (from Resolution 18.15)

NOTING FURTHER the following goals that are fundamental to achieving ecologically sustainable development:

- the improvement of individual and community well-being and welfare by following a path of economic progress that does not impair the welfare of future generations;
- the provision of equity within and between generations;
- recognition of the global dimension;
- the protection of biological diversity and the maintenance of ecological processes and systems;

NOTING FURTHER that the means of achieving ecologically sustainable development will include:

- increased efficiency of resource use and reduced waste production;
- management and utilization practices that improve the resilience of natural resource systems;
- dealing cautiously with risk and irreversibility;
- integration of environmental and social goals into economic decision-making, including ensuring that environmental assets are appropriately valued;

RECOGNIZING the importance of:

- stabilizing global human population in the long term;
- greater public involvement in decision-making;
- establishment of adaptive and effective institutional arrangements and policy measures;

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

1. URGES all national and regional governments to develop national strategies for ecologically sustainable development, and to cooperate internationally to achieve ecologically sustainable development globally;

2. RECOMMENDS that the goals fundamental to the achievement of ecologically sustainable development as outlined above be adopted by countries and implemented by the means indicated above or by other means that may be appropriate to particular national circumstances.

Executive Brief

PREAMBLE

This National Environment Strategy contains over 400 specific recommendations and suggested actions in the field of environmental protection and conservation. Because it has been formulated by some 180 Jordanian specialists with substantial hands-on experience in the country, it is practical, realistic, comprehensive, integrated, and forward-looking. Readers wishing to delve into the particularities of a specific sector should turn to that chapter. This executive brief discusses five recommended strategic directions for action. The first four pertain to all sectors of environmental protection, and, if followed, would render the implementation of the sectoral recommendations easier and more efficient.

STRATEGIC INITIATIVES TO BE UNDERTAKEN

1. Constructing a legal framework for Environmental Management

The existing laws and administrative directives pertaining to the environment have been developed in a piecemeal manner, and consequently are often ineffective and less than comprehensive. A new overall legal framework is required, with three main thrusts:

a. to formulate a single, comprehensive and integrated National Environmental Policy that would include the formation of a Higher Council for Environmental Protection. The council would be charged with monitoring compliance with environmental legislation, coordinating among all concerned national bodies, and implementing the National Environmental Policy and its specific sectoral plans.

b. to enact "environmental management" legislation that would empower the Department of Environment to fulfil its mandate by giving it greater legal and enforcement authority than it now enjoys.

c. through the same environmental management legislation, to create a national Environmental Impact Assessment process that would ascertain the environmental impact of all new development and construction projects and other activities that might have an adverse impact on the environment of Jordan, before they are approved and initiated. Such a process should be coordinated by the Department of Environment.

Action recommendation: The Government of Jordan should seek international and local advice on how best to package such legislation, drawing on a quarter century of

global experience in this field. Clearly, Jordan cannot simply copy existing legislation from other countries, because such legislation may not work efficiently in those countries and it may not be appropriate for Jordan. Yet, tapping the substantial experience of others would be highly efficacious, and cost effective. One good source of advice is the IUCN Environmental Law Centre in Bonn, Germany.

2. Institutional Strengthening

Existing institutions working for environmental protection and conservation must be strengthened across the board, including funding, staffing, training, equipment, educational outreach, and legal authority. The two key institutions today are:

- a. The Department of Environment: Its role is primarily to regulate and enforce environmental protection measures. It can be strengthened by enacting enabling legislation, and by obtaining additional financing from within Jordan and from foreign assistance grants to enhance its technical capabilities.
- b. The Royal Society for the Conservation of Nature: Its efforts focus primarily on nature reserves and wildlife protection. It can be strengthened by enhancing its capabilities in planning and management, teacher training, environmental impact assessments, technical library and in-house workshop resources, computerized data bases, and air photo interpretations.

3. An Expanded Role for Jordan's Protected Areas

Jordan's protected areas can play a greater role in national environmental conservation efforts through quantitative and qualitative means.

- a. Quantitative actions: Three new nature reserves should be created at Wadi Rum, Dana and Burqu, to complement the seven other reserves that are operational or under establishment. A Marine National Park should be established at Aqaba, comprising the coastal zone from the Aqaba Marine Science Station to the Coast Guard Station. Several areas within the marine park could be designated as marine reserves (for greater protection) and multiple use areas (to accommodate tourism services). The core area of Azraq Oasis should be rehabilitated, in order to prevent further salinization of underground water resources and to preserve this internationally important wetland.
- b. Qualitative actions: Existing managed areas can be expanded to include additional environmental and conservation elements. For example, antiquities sites can be fenced to play the additional double role of nature areas and sites for biological diversity. Multiple purpose managed areas are particularly important for Jordan today, in view of the brisk pace of construction throughout the country, which frequently encroaches on formerly unthreatened natural zones.

4. Bringing Environment to the People

The ultimate safeguard for Jordan's environment will be public knowledge, awareness, support and activism. These must be instilled or expanded in the minds of all Jordanians, regardless of age, sex, education, income level, place of residence, or professional qualifications. Seeds must be sown today that would catalyze such a process on several fronts, including programmes in:

a. Environmental education, conducted through schools, literacy centres, vocational training institutes, colleges, and other educational institutions.

b. Conservation education, conducted through schools, clubs, community centres, the media, and other such institutions.

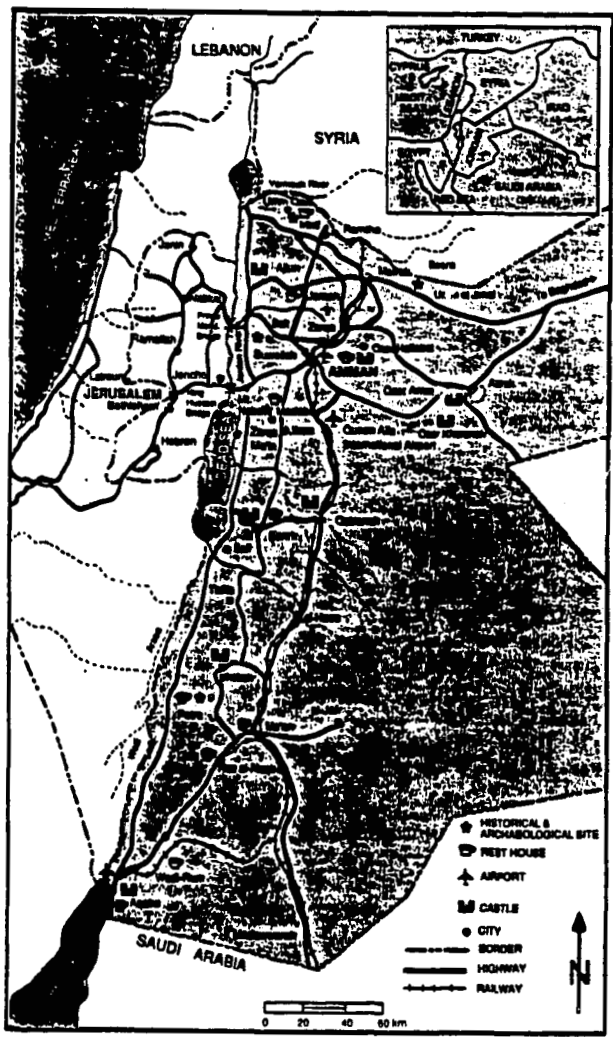
c. An urban system of nature parks, which would parallel the existing nature reserves managed by the Royal Society for the Conservation of Nature. As nearly 70 percent of all Jordanians live in towns and cities, their primary (often their only) exposure to "nature" will be through such urban parks and picnic areas. The popularity of the Amman National Park south of the capital attests to the demand for such facilities. Jordan's main cities are woefully under-provisioned in green spaces.

d. Bringing Jordanians into nature resources/environmental decision-making, through an Environmental Impact Assessment process that includes a mechanism for public participation. As people become more aware of how environmental degradation has an adverse impact on their quality of life -- especially in crucial or very high profile areas such as water or waste disposal -- they will seek to be more involved in decision-making. This is also compatible with the political decision-making system of the country and its move towards greater public accountability of government officials as well as private businesses.

e. Bringing environmental health awareness and services to local communities and households. The family is the core unit in any community or national effort, and must be informed and mobilized in any serious endeavours for environmental protection. The linkages between environmental health issues and quality of life must be made more clear to families. Their latent interest is there because they are already engaged in addressing practical needs such as clean water or garbage and sewage disposal. Just as families and local community forces were successfully mobilized to achieve high infant protection rates through immunization, the family at grassroots level must become more informed about and involved in good environmental health practices.

5. Sectoral Priority should be given to water and population issues, both of which will have serious long-term impact if they are not addressed urgently. Jordan's water resources are limited and erratic, and some are threatened by salinization, pollution or depletion. Should they fall prey to widescale environmental deterioration, the detrimental consequences to every aspect of life in the country would be swift and significant. Rapid population expansion, combined with extensive physical development of the land, add substantial new pressures to a delicate natural environmental balance. Drawing on its rich social heritage and its Arab/ Islamic values, Jordan must strike a more careful balance between its fast expanding population and the ability of its natural resources base.

Map of Jordan and Environs



1 • Geographical Overview²

By virtue of its special geographical location in the heart of the middle east region and the Arab world, Jordan has long served as a corridor linking neighbouring and remote countries of Africa, Asia and Europe. From the onset of history, Jordan was a pathway for caravans traversing Arabia to India and East Africa to the Mediterranean through the great caravan road heading from Hadramaut and Yemen to Hijaz and Mad'en Saleh to reach the Moabite lands in the east Jordan mountains. It was also connected with Iraq and countries east of the Arabian peninsula, and with Syria to the north and the Mediterranean ports to the west.

1 LAND & VEGETATION

1.1 Location

Although Jordan's size is limited, the landscape reveals great diversity within short distances. As a middle eastern country, Jordan is located between N. Latitudes 29° 11' and 33° 22' and E. Longitudes 34° 59' and 39° 12'. It is bordered by Syria to the north, Iraq to the east, and Saudi Arabia on both eastern and southern fronts. The Gulf of Aqaba, located in the southwest of Jordan, is the country's only outlet to the Red Sea. Jordan's western boundary is defined by the Jordan River and Palestine (Israel).

1.2 Topography

Jordan's area is 90 thousand km², three-fourths of which is desert. The three main physiographic regions of Jordan trend in a north-south alignment and comprise tropical desert in the central Ghor or rift valley, escarpments and mountain highlands east of the Ghor and desertic plains in the Syrian *Badia*.

Jordan Valley Region-Jordan Rift (Ghor). This gigantic fault extends from Lake Tiberias in the north to the Gulf of Aqaba in the south. This region has the unique distinction of being the lowest depression on earth, where, in the Dead Sea area, it reaches a maximum of 400 m below sea level.

This is a part of the Great African Rift, stretching from East Africa to southern Turkey. The Jordan Rift stretches from the meeting point of the Yarmouk River with the Jordan River in the north to the Gulf of Aqaba in the south, and is 370 km long. The Jordan River constitutes the northern part of the Jordan Rift. It has a winding course, and its width varies from 20 to 30 m. The southern part of the rift is named Wadi Araba.

The Ghor region is separated into two main parts, divided by the Dead Sea: the Northern Ghor, containing 81,250 hectares of agricultural land; and the Southern Ghor, which has an area of 15,000 hectares. The Yarmouk River, in addition to the Jordan and Zarqa rivers, constitutes the major source of water in the Ghor area.

The Mountain Heights Region. Mountains extend from Irbid in the north to Ras Naqab in the south. This region is dissected at several locations by incised wadis, such as Wadi Mujib. Some of these mountains range between 1200 and 1500 m elevation in the southern sector. The heights are generally higher than those in the West Bank. This region lies between the Yarmouk River and Syrian border in the north, the Ghor and Wadi Araba in the west, Wadi

²Sources: prepared by Suleiman Hanbali, Department of Environment. Data are drawn from: (i) Dr. Dawid M. Al-Eisawi, Department of Biological Sciences, University of Jordan, "Vegetation in Jordan"; (ii) Dr. Salah Eddin El Buhiri, *Jordan's Geography*, first edition, 1973; (iii) The Royal Jordanian Geographic Centre, 1984 periodical, "A Window over Jordan"; (iv) The Jordan Meteorological Department, *The Climatic Atlas of Jordan*, Amman, 1987.

Musa in the south and the *Badia* in the east and south. It includes mountains at Ajloun, Balqa, Moab and Shara in the south. Other mountains are located between Naqab and the Saudi Arabian border. Of special interest are Wadi Rum and Rum Mountain, which is the highest in Jordan at 1754 m, and Um Eshrin Mountain at 1753 m.

The Badia Region (Eastern Desert). This extensive region comprises most of the country. It links with the Arabian Desert at the borders of three Arab countries, Syria, Iraq and Saudi Arabia from the north, east and south, respectively. It is a plateau with an elevation of 600 to 900 m, extending eastwards. A part of the Syrian *Badia*, it comprises most of Jordan's area, and has diverse characteristics. Most of the *Badia* region is divided into two broad areas: (i) Hammad Land, which stretches from Naqab to the Jordan-Iraqi borders in the northeast; and (ii) the volcanic area of Hurra Land, which is a part of Hurra of the Syrian *Badia*, and extends from southwest Syria through northeast Jordan.

These dissimilar physiographic regions explain why there is such climatic variation found within the restricted area of Jordan.

1.3 Natural Plants

Desert plants grow in the eastern areas, while forests of various types of oak and pine, as well as *Seratona siliqua*, *Pistacia carob* and *cinnabar* trees, grow in the heights—especially in the north.

The agricultural area in the Kingdom is almost 3.1 million dunums³, representing 4% of the total area of Jordan. In 1985 crop land was 1.5 million dunums, while 554 dunums were used for fruit trees and 496 thousand dunums were planted with vegetables; 80% of cropland is irrigated and 20% is non-irrigated (rain-fed).

2 CLIMATE

The Mediterranean climate prevails in the heights region, where summer is moderate and dry and the winter cold and rainy. The desert climate prevails in the *Badia*; the summer is hot and the winter is cold. The Ghor area has a semitropical climate with a hot summer and warm winter. The range of average annual temperatures is 22° to 25° C in the Jordan Rift area, 18° to 21° C in the *Badia*, and 14° to 18° C in the heights.

2.1 Rainfall

Data from 31 stations for the period of 1966-80 show that precipitation ranges between 50 to 500 mm annually, depending on the location. The lowest amount of rain was recorded at Wadi Araba (50 mm) while the highest was at Ras Muneef in the Ajloun area (500 mm).

The rain normally falls during winter and spring starting as early as November and possibly extending to April. Usually the maximum amount is during January. The amount and the period of rainfall are very variable and fluctuate from year-to-year; there is often hardly any rain until December or even January, and at some other times there is no rain after the middle of March. Generally speaking, the amount of rainfall decreases from north to south and from west to east.

Rainfall increases in the western heights, from west to east, to the divide between the Dead Sea and the Mediterranean drainage basins. It then decreases substantially nearer to the Ghor. The quantity of rainfall also decreases as we go from north to south; the annual average in the northern parts of the western heights reaches more than 600 mm, whereas it is less than 300 mm in the southern parts of these heights. The annual average in the eastern heights, in the Ajloun Mountains, reaches 400-600 mm, then decreases to 300-600 mm in the Balqa mountains, 200-350 mm in the Moab mountains, and 100-300 mm in the Shara mountains. The annual average in the northern part of the rift reaches 300-400 mm but

³One dunum = 1,000 square meters, or 10 ares, or 0.1 hectare, or 0.247 acres.

drops to 100-200 mm north of the Dead Sea and 50-100 mm in the Dead Sea area north of Wadi Araba. The southern part of Wadi Araba and Aqaba Gulf receive less than 50 mm. Rainfall varies from year-to-year, while occasional light snowfall is restricted to the highest areas.

2.2 Temperature

The temperature is highly affected by the topography and latitude. The mean annual minimum temperature for the period between 1966-80 ranged between 5° C in Sharah mountains, and 20° C in Aqaba. The mean annual maximum temperature ranged between 30° C in Wadi Araba and 20° C in the mountain ranges.

These values vary from year-to-year and even from season-to-season, especially if we consider that the temperature may drop to below zero in the coldest month with frost formation in some places. At the other extreme, it may reach 50° C in locations such as the Rift Valley.

3 POPULATION

A census of houses was made in Jordan in 1952, and the population was enumerated. However, the first true population census was not carried out until 1961. Another census was carried out in 1979, but covered only the East Bank of Jordan.

The population in 1952 numbered 1,329,174, with 586,885 in the East Bank and 742,289 in the West Bank. In 1961 the number was 1,706,226 inhabitants: 900,776 in the East Bank and 805,450 in the West Bank. In the November 1979 census, the population in the East Bank was 2,152,273, while the number in the West Bank was estimated at 718,600. The 1991 population estimate for Jordan is 3,571,000.

The improvement of social and economic conditions and the migration from rural to urban areas led to an increase in the urban population percentage: from 36.3% in 1952 to 43.9% in 1961, to 60.3% in 1979. At present, 70% of Jordanians are living in urban areas.⁴

⁴Settlements of 5,000 population and larger are classified as urban.

2 • Agriculture & Lands⁵

The strategy aims at managing natural resources in a way that conserves the basic natural resources which are necessary for human growth and survival, such as soil, water, plant cover and climate, and developing these elements and using them appropriately.

Secondary aims are to maintain (i) biological diversity by protecting the various species of animals, plants and micro-organisms in their different agricultural environments; and (ii) productivity of environmental systems, especially forests, grazing land and agricultural land within a balanced environmental order.

The strategy should be accomplished urgently, for the following reasons:

- a) The agricultural lands' ability to feed the population is decreasing continuously due to increased soil erosion as a result of plant cover destruction and urban expansion.
- b) Many urban and rural people are obliged to destroy land resources in order to meet their increased needs by cutting trees, bushes and plant cover to use as fuel or animal feed, and by burning animal waste and residuals of crops which are necessary to enrich the soil. Moreover, the increased use of machinery leads to the deterioration of the environment, and ploughing marginal lands and forests for use in unsuitable farming leads to desertification.
- c) Soil erosion and sedimentation shorten the life span of dams and reservoirs and decrease their storage and power generation capacity, as is the case with the King Talal Dam. Annual floods also destroy crops and facilities in different parts of Jordan.
- d) Exceeding safe groundwater extraction limits leads to deterioration of water quality, increased salinization and long-term depletion.
- e) Misuse of agricultural inputs, and land pollution from plastic wastes and use of waste water.

1 OVERVIEW OF ISSUES

Subjects include agricultural and land resources in the main geographic areas of Jordan—climate, water, grazing lands, animal resources and forests. Jordan has been divided into the following geographic areas:

- 1) Jordan Valley and Southern Ghor area.
- 2) Highlands area with annual rainfall rate over 250 mm.
- 3) Marginal areas with annual rainfall rate of 100-250 mm.
- 4) The *Badia*, with annual rainfall rate below 100 mm.

1.1 Environmental Issues in Agriculture and their Priority

Area of Jordan Valley, Southern Ghor – first priority

- Use of waste water in irrigation.
- Misuse of technology (organic fertilizers, hormones, plastic).
- Population settlements, sewerage systems and pollution.
- Increased soil salinization.
- Deteriorating quality of irrigation water.
- Floods from side valleys.

⁵Information in this chapter was prepared by the Agriculture Committee, under the chairmanship of Dr. Sami Sunna, Secretary General, Ministry of Agriculture.

Area of Jordan Valley, Southern Ghor – second priority

- Deterioration of soil fertility.
- Trespassing on government lands.
- Climatic elements (eastern winds, fluctuating rainfall and frost formation).

Mountainous Highlands – first priority

- Using waste water.
- Soil erosion by water.
- Forest destruction and removal.
- Misuse of lands and destructive agricultural practices.
- Laws on agricultural resource protection, land management and fragmentation of property.
- Depletion of groundwater and inefficient use of water for various purposes.
- Population settlements, sewerage systems, pollution, and use of agricultural land for urban expansion.
- Using fertilizers, insecticides and plastic houses on irrigated lands.

Mountainous Highlands – second priority

- Climatic elements, including frost, strong winds and rainfall fluctuation.
- Over-grazing and mountainous grazing-land deterioration.
- Waste-disposal sites and groundwater-source pollution.

Marginal areas with rainfall of 100-250 mm – first priority

- Soil erosion by water and wind.
- Over-grazing and cutting of grazing shrubs.
- Misuse of lands and trespassing on government lands.
- Depletion and salinization of groundwater and low irrigation efficiency.
- Agricultural resource protection laws and their implementation.
- Distribution of population settlements.
- Desertification, and climatic elements including limited and fluctuating rainfall and high evaporation rate.

Marginal areas with rainfall of 100-250 mm – second priority

- Waste disposal sites and sewerage systems.
- Soil salinization.
- Treatment plants, and sites and uses of waste water.

The Badia – first priority

- Shortage, misuse and poor quality of water.
- Soil salinization and expansion of sand and gypsum lands.
- Climate (evaporation, frost, wind).
- Destruction of plant cover by over-grazing, cutting and vehicles.
- Desertification, which is increasing progressively.
- Population settlements.
- Soil erosion by wind and water.

2 OVERALL ASSESSMENT OF SECTOR RESOURCES***2.1 Jordan Valley & Southern Ghor***

The Jordan Ghor. This area measures 120,000 hectares and is considered the main agricultural area in Jordan. It depends mainly on irrigation water from the Yarmouk River through the east Ghor Canal, and from the Zarqa River and side valleys.

The area of cultivated lands is 350,000 hectares, 85% of which are north of the Dead Sea. Climate in this area is very hot in summer and warm in winter, resembling that of tropical areas. Water resources of basins flowing into this area are estimated at 734.5 million cubic

litres, 688 million of which are surface water and 46.5 million groundwater, used for drinking, agriculture, industry and other purposes outside the area. Surface water is found in the Yarmouk Basin, the side valleys of the Jordan River, Zarqa River Basin, Dead Sea Basin, Mujib, Hasa and South Ghor. Groundwater is found in the Jordan River side valley basin, Jordan Valley Basin, Wadi Ibn Hammad, Mazra'a, Haditha, Wadi Hasa south, Ghor Safi, and Wadi Araba Basin north.

Soils. The soil of this area was derived from four main sedimentations: (1) Lisan, which contains plentiful quantities of minerals and calcium carbonate and gypsum. These components increase as we go southwards. (2) Damia Lake sedimentation, which was formed after the drying up of Damia Lake and contains lesser quantities of minerals, carbonates and gypsum than does the Ktar. (3) Sedimentations formed by soils transferred from surrounding mountains and deposited over Ktar Lisan; all highly productive agricultural lands were formed of this sediment. Grained components which have settled on mountain-sides decrease as we go westwards, while the depth of the soil increases as we go eastwards. There are also some saline soils which have resulted from the mixture of this sediment with Ktar Lisan or the Damia sediment. (4) Jordan River sedimentation, which results from the flooding of the Jordan River, is known as *azzour*. This soil is characterized by a thick mixture and weak development, and suffers bad drainage in some areas. It is considered one of the best agricultural soils in the Jordan Valley.

The Jordan Valley. This area is considered poor in plant cover since there are no natural forests there; 3,000 hectares in the areas overlooking the Ghor were planted, and the current plan provides for afforesting 1,000 hectares each year. The main species planted are varieties of acacia. The area is considered poor in herbaceous grazing plants due to over-grazing, and there are also a number of poisonous plants.

The area contains relatively small numbers of livestock, estimated at 162,000 head, distributed as follows (in thousands of head):

Number of Livestock – Jordan Valley
(in thousands of head)

Sheep	Goats	Cows	Other	Total
116	40	4	2	162

Environmental pressures. Indications regarding current and future trends:

- The Ghor area experiences some pollution by waste water, insecticides, plastic and hormones; also, in most years the area is prone to floods and resulting residuals from the surrounding areas. Salinization, soil-quality deterioration and lack of fertility are emerging in many areas.
- It is expected that water consumption for potable, domestic and industrial purposes will increase at the expense of irrigated areas, and that increased quantities of waste water will be mixed with irrigation water for agriculture.
- It is expected that more dams will be established, such as the Wehda Dam and a number of other small dams.
- It is expected that cultivated lands will be increased by the planting of forests and grazing lands. It is also expected that the number of animals depending on natural grazing will decrease.

2.2 Mountain Areas

Physical geography. The mountainous heights area measures approximately 5.5 million hectares. More than 80% of the area of the Kingdom's cities and villages fall within this area, and amount to 100,000 hectares, in addition to almost 70,000 hectares of forests. The rest of these lands are either cultivated or abandoned. Groundwater available for safe extraction is estimated at 60.5 million m³/yr in the Amman-Zarqa Basin (Baq'a, Jerash, Rmeimin), Yarmouk Basin, Wadi Daher, Wadi Zarqa and Ma'in in the Dead Sea Basin, and Shobak and

Ras Naqab in the Jafer Basin. The climate is moderate and dry in summer, cold and humid in winter.

Most of this area's land is composed of limestone with basalt. There are indications that some large areas were formed as a result of a more humid climate than the one prevailing now. Deep soils are found in areas with an incline of less than 8%. Vertisole lands occupy areas with an incline of less than 5%; inceptisols in central areas are less than 12% steep. The main soils are used to cultivate field crops. Entisol, found in slopes of over 12%, is of medium mixture, not deep, and suffers from continuous erosion.

Forest cover. Natural and artificial forests, comprising 35,000 hectares of government-owned forests and private forests of 47,000 hectares. They are of the following types:

- Evergreen broadleaf forests of a 25,000 hectare area. Main element is *Quercus coccifera* trees in the north and south.
- Deciduous broadleaf forests of a 4,000 hectare area. Main element is *Quercus aegilops* in the north.
- Conifer forests covering 8,000 hectares, with *Pinus halepensis* in the north and *Junipers phoenician* in the south.
- Mixed forests covering 3,000 hectares, with *Pinus halepensi* and *Quercus coccifers* in the north.
- *Oleo eyropea* forests covering 100 hectares in the Burma area around Jerash.

Artificial forests with an area of almost 30,000 hectares are found in shallow soil on slopes which vary between a 15-50% incline level. They are 500-1200 m above sea level.

Grazing. Natural grazing area is estimated at 45,000 hectares of dispersed plots of lands. Grazing also occurs in natural forests, which comprise 40,000 hectares. Although this area is relatively small, it is considered among the most important grazing lands, rich in plant cover because of high rainfall rates. It is also important because animals depend on the stubble of crops after harvest, especially wheat, barley, legumes and vegetables.

Natural grazing land, as well as barley and hay production from grains and legumes, comprise the main forage production which maintain livestock during winter. These grazing areas are shrinking because of over-grazing, land reclamation and the planting of fruit trees and artificial forests.

There are almost 635,000 head of livestock distributed as follows (in thousands of head):

Number of Livestock - Mountain Areas				
(in thousands of head)				
Sheep	Goats	Cows	Other	Total
450	160	14	11	635

List of environmental pressures.

- Many indications show that the area is affected by desertification factors—mainly the recession of plant cover and increasing erosion of agricultural soil.
- It is expected that water consumption for potable, domestic and industrial purposes will increase at the expense of irrigated areas in the highlands which depend on groundwater. The number of dams is also expected to increase in the area.
- It is expected that areas cultivated by forests and grazing lands will increase and that the number of animals depending on natural grazing will decrease.
- Natural forests are deteriorating and should be renewed. In some cases they are heading towards extinction due to the removal of trees to plant fruit trees and crops, despite the unsuitability of the area for that purpose.
- Increased danger of fires and trespassing in forests, in addition to the increased number of destroyed trees (more than 50,000 a year). This destruction is expected to increase if no control measures are taken.

2.3 Marginal Steppe Areas

Physical geography. The extent of the marginal steppe is approximately one million hectares stretching from the north to the south along the desert's western borders. It is treeless, but there are herbs and bushes. As a result of over-grazing and land misuse, the area suffers from desertification and loss of plant cover. Groundwater quantity for safe extraction amounts to 92 million cubic m in the northern *Badia*, Dhuleil, Amman, Zarqa, Qastal, and Zizya to Dab'a from the Dead Sea Basin. A blend of mountainous and desert area climates prevails in marginal lands due to the small area between them. The result is a warm, dry climate in the eastern heights, and a dry, moderate climate in winter in the steppe area close to the desert in the areas of Amman, Mafraq and Wadi Dhuleil.

Soil in this area is derived from lime rocks or lime accompanying basalt rocks in some areas. The soil depth decreases as the inclination becomes steeper than 4%. Soil rich in lime is found in areas of 4-6% inclination. The most important characteristics of this soil are high rates of silt and calcium carbonate. Salinization and gypsum increase as we go eastwards. The low level of organic matter and the formation of surface crust cause high rates of erosion. The main types of soils prevailing in areas below an inclination level of 10% are aridsols, and entisol in steeper areas.

Grazing use. The major and traditional grazing areas for livestocking can be divided into bush-covered areas comprising 600,000 hectares and herb-covered areas of 400,000 hectares in extent.

The area suffers from land misuse, over-grazing and cutting of grazing bushes. Fifteen grazing reserves have been established, with an area of almost 18,000 hectares, in which soil and water preservation and range management are practiced (see Wildlife and Habitat Sector Report).

The area has almost 690,000 head of livestock, distributed as follows:

Number of Livestock – Marginal Steppe Areas (in thousands of head)

Sheep	Goats	Cows	Other	Total
492	170	12	16	690

Environmental pressures. Indications regarding current and future trends reveal the following:

- The steppe areas reflect the increased effect of desertification. They are heading towards plant cover destruction and are subject to severe erosion by wind and water, in addition to the emergence of poor-quality soils, which increase erosion.
- It is expected that irrigated areas depending on groundwater will shrink due to the depletion of groundwater and wells.
- It is expected that the quantity of animal resources depending on natural grazing lands in the area will decrease due to destruction of lands and plant cover. Grazing reserves are expected to increase in the area.

2.4 Badia

Physical geography. The *Badia* encompasses 7 million hectares and receives an average annual rainfall of less than 100 mm. The prevailing climate is dry and hot during the summer and very cold during winter, with rain in the form of thundershowers. *Badia* climate resembles that of tropical areas, characterized by substantial variance in temperatures between day and night. Groundwater available for safe extraction is estimated at 189 million cubic m in Azraq Basin, Wadi Mujib, Siwaqa, Qatrana, Sultani, Wadi Abyad, Hasa Upper, Jurf Darawish, Wadi Araba Basin, Jafer, Wadi Msheish, and Shadiya-100 million cubic m of which is in the Disi, Mudawwara, Sarhan, Hammad Basins (non-renewable). There are also 65 million cubic m of flooding and continuously flowing waters

in Yutm and the southern desert, Jafer, Sarhan, Azraq and Hammad. Thus, the total quantity of water available for safe use in the *Badia* areas is 254 million cubic m.

There are two main types of soil in this area. The first type was formed as a result of the desert climate; the second was formed as a result of a humid climate, but now falls under the effect of the desert climate. These soils were developed from basalt, which prevails in northeastern areas and some areas east of Ma'an. They are characterized by high percentages of salts and lime. The soils of the southern area and Wadi Araba, and southeastern areas (Disi and Mudawwara), are derived from sandstone or granite. They are grained, of weak mixture and contain variable rates of salt and gypsum. Soils in the eastern and central areas are affected by lime rocks, and there are soils rich in gypsum, especially in flat plains. Depth increases in areas of inclination of less than 4% and decreases with increased steepness. Soils in lands surrounding valleys and carried by water are of good quality and can be used for agriculture.

Land use. *Artimisia alba*, *Rattamus*, and others are found in valleys and waterfalls. *Anabasis*, which is unfavourable for grazing, prevails in other areas. Plant cover in the area is very poor; its production capacity is estimated at 40 feed units/hectare, whereas production capacity in some valleys of the Jordan Hammad is estimated at 350-650 kg dry matter/hectare.

Two grazing reserves were established in Azraq and Wadi Butum, with an area of more than 32,000 hectares, in addition to that in the Shaumari Wildlife Reserve. These reserves proved that the productivity of natural grazing lands can be doubled through protection, improvement and managed grazing (see Wildlife and Habitat Sector Report).

The area contains 344,000 head of livestock, distributed as follows (in thousands of head):

Number of Livestock - <i>Badia</i> (in thousands of head)				
Sheep	Goats	Cows	Other	Total
221	110	-	13	344

The area is subject to over-grazing by sheep from neighbouring Arab countries.

Environmental pressures. Indications regarding current and future trends show that:

- Desertification is progressing due to the prevailing dry climate. Sand rocks dominating the southeastern area led to the formation of sand dunes, causing a decrease in the productive capacity of the area. Major problems are increased salinization and recession of plant cover. It is expected that negative impacts will continue to be felt as even more sand dunes form.
- Most rain-water falling in the area is lost by evaporation. It is expected that large quantities of groundwater will be depleted and salinized unless a safe extraction level is established.
- Water demand for potable and domestic purposes will most likely exceed that for irrigated areas reliant on groundwater.
- Some preliminary studies indicate the possibility of increased rainfall over the next 50 years with a change in the nature of rainfall and a slight decrease in temperatures which would affect the *Badia* area positively.
- It is expected that more grazing and nature reserves will be established, especially in Hammad basin, which will increase the productive capacity of some developed areas, though no increase is expected in the number of livestock depending on natural grazing lands.

3 CAUSES OF DEPLETION AND DEGRADATION

3.1 Land Resources and Soil

- Pollution by plastic waste, especially in the Jordan Valley and irrigated lands, the accumulation of pesticides and chemical herbicides and their negative impact on the soil.
- Pollution by waste water, especially in the Ghor, Zarqa River and Wadi Shuaib.
- Salinization of the soil, especially in the Ghor and marginal areas, and the expansion of gypsum and saline soil in the *Badia*.
- Problems of agricultural discharge, especially in the Jordan Valley.
- Poor soil properties, especially in the central and southern Ghor, and the deterioration of natural soil properties in the highlands, marginal areas and the *Badia*, in addition to low fertility of soil in the southern and central Ghor, plus shortage of nutrients and loss of fertile surface layer in the highlands, marginal areas and *Badia*.
- Erosion by wind in the southern Ghor, the highlands, marginal lands and *Badia*.
- Erosion by water on hillsides overlooking the Ghor and Wadi Araba, the highlands, marginal areas and *Badia*; and increased desertification in the *Badia* marginal areas and highlands.
- Movement of sand dunes and migration of soft sand in Ghor Safi and the *Badia*, and the expansion of sandy lands in the *Badia*.
- Sewerage discharge problems in the Ghor, and sites of wastes and waste water disposal in the highlands and the marginal area.
- Property-ownership problems in the Jordan Valley and fragmentation of ownership in the highlands and the marginal area.
- Wrong practices in farming, especially the use of unsuitable agricultural techniques in the Ghor and the highlands; cultivating marginal land, not using adequate soil-preservation techniques, and using land to produce unsuitable crops.
- Problems resulting from human settlements, characterized by the population increasing in the highlands and decreasing in the *Badia*, and irregular population growth in the Jordan Valley and marginal areas.
- Losses in crops between harvesting and reaching the consumer, in addition to losses resulting from agricultural diseases.

3.2 Water Resources

- The flow of waste water from Khirbet Samra to the Zarqa River has affected water quality and agricultural patterns. It has also been detrimental to health and the environment in the whole area, and has led to the deterioration of water quality in the King Talal Dam, where the salt rate has reached 1300 parts per million. Waste water from treatment plants in Irbid, Karak, Kufranja, Ramtha and Salt has also affected the health and environmental situation. This was accompanied by social, economic and bio-physical changes.
- Pumping potable water from wells in the Zarqa Basin reduced the water reserves in the area. Over-pumping of wells in the eastern area (Dhuleil, Azraq, Disi) has also caused deterioration of water quality and increased its salinization.
- The East Ghor canal, being uncovered and close to villages and towns, has been subject to pollution from domestic wastes and chemicals, which in turn has increased health hazards and affected social conditions.
- Using fertilizers like nitrates and agricultural pesticides has increased water pollution, especially groundwater in Baq'a Basin, the Ghor and irrigated areas.
- Irrigation suffers from a shortage of irrigation water, the high cost of its extraction, and low efficiency of irrigation techniques.

3.3 Climate

The atmosphere is inherently capable of absorbing natural elements and reinstating a balance within a limited period of time. However, the increased human activities affecting

the atmosphere have exceeded the atmosphere's ability to reinstate a balance, leading to a disturbance of the natural equilibrium and causing climatic changes. The main factors of depletion are:

- Increased use of fuel leading to emissions of CO₂ and greenhouse gases which help change the climate.
- Expansion of industries depending on chlorofluorocarbons, which lead to the depletion of the ozone layer.
- Destruction of forests by cutting, fires, grazing and other factors which lead to disturbing the natural balance and increasing air pollution (see Atmosphere and Air Quality Sector Report).
- Increased effect of desertification in all areas (see Atmosphere and Air Quality Sector Report).

3.4 Forest Resources

- Fires due to negligence and recreation are the main threat to Jordan's forests, as they destroy almost 30,000 trees each year.
- Illegal tree-cutting for fuel and wood and wrong use of agricultural equipment lead to the destruction of 10,000 trees each year.
- Legitimate cutting, which happens continuously during road construction or expansion, or by changing privately owned forest lands to other uses, leads to the destruction of 20,000 trees each year.
- Grazing in forest areas continues due to a shortage of grazing and forage resources and the advent of occasional droughts. Two hundred cases of illegal grazing in forest areas each year lead to the annual destruction of around 5,000 small trees.
- Trespassing on forest lands by ploughing, planting, construction and expansion of cities and towns. Five hundred cases each year lead to the destruction of 5,000 trees.
- Illicit activities and the unlicensed transfer of forest material, such as wood, fruit and soil, upset the natural balance.
- Insects, diseases and natural elements of various types, including drought, lead to destruction of new plants.
- Pollution: gas emissions from factories and vehicle exhaust poison plant tissues, which are also subject to dust pollution caused by vehicles during the opening of roads and in quarry areas.

3.5 Grazing Resources

- Lack of a clear agricultural policy to determine uses of eastern lands according to their productive capacity; also, the protection and management of grazing lands are not assigned to a single agency.
- Giving grazing lands, especially in areas of average rainfall between 100-200 mm, to local residents who plough them and destroy their plant cover, and who plant crops unsuitable for such an arid climate; also, taking over government-owned land of less than 200 mm rainfall, claiming ownership, then ploughing and destroying the plant cover.
- Weakness of the Law of Agriculture regarding grazing lands, especially the implementation of suitable land-use regulations and the lack of suitable punishments for violations.
- Scarcity of technical specialists in the field of range management and desertification. There is also no agency to teach people of the importance of natural grazing lands and the importance of public participation and co-operation in developing these lands.
- Weak interest in growing forage in rain-fed and irrigated lands, which could decrease the pressure on natural grazing lands.
- Continued negative practices like over-grazing, early grazing, cutting bushes and small plants, and haphazard use of machinery; lack of awareness among local residents as to the importance of using land in accordance with its productive capacity.

3.6 Animal Resources

- Low production efficiency of local animals and high cost of production.
- Slaughtering animals at early ages and low weights.
- Low prices of imported animal products as compared to local products.
- Insufficiency of local forage production, and inability of grazing lands to ensure the required feed needs for animals.
- Inadequate health care for animals.
- Absence of adequate organization for production of forage and animal products, and lack of development in the techniques of livestock breeding, improvement and research.

4 RECOMMENDED ACTIONS TO PROMOTE SUSTAINABLE AGRICULTURE

4.1 Land Use

Public land use policy. There is a problem with the concept of *optimal* land use when applied to agriculture. For example, the area of dry climate comprises almost 91% of the total agricultural lands in the Kingdom. Lands suitable for field crops comprise 2.9% (7,982,000 dunums) of the total area. The area suitable for agriculture is 3,079,000 dunums⁶, of which 2,582,000 are rain-fed and 497,100 are irrigated. Land within the boundaries of local councils, which can be used for construction and other uses in over 600 population settlements, falls within the second and third areas. Therefore, due to non-availability of large areas, public land-use policy which defines optimal land use for the highest yield cannot be implemented. It should be replaced by the principle of priority use of agricultural lands, regardless of economic yield. In view of the above, the following actions are recommended:

- a) Assign to one agency the responsibility of defining land use.
- b) Ban use of agricultural lands in areas where annual rainfall is over 250 mm for any other purposes.
- c) Due to the lack of information and maps necessary to define land use, licences should not be given to permit use of land where soil is more than 250 mm deep for any purpose other than agriculture, regardless of the size of the land, in areas where annual rainfall is over 200 mm.
- d) The principle of land use should be strictly implemented, such as preventing planting trees in lands suitable for field crops.
- e) Give priority to using lands for agricultural purposes over any other purpose, irrespective of whether or not the yield is at maximum.
- f) Link the policy for establishing housing projects with land-use policy.
- g) Implement laws which encourage soil-preservation practices, such as decreasing ploughing as we go downwards in the second and third areas and preventing ploughing completely in the third and fourth areas through clear and approved land-use criteria.
- h) Land-use laws should reflect the principle of ownership as the right to use land on the condition that conservation of such land be guaranteed, and that violation of this principle is a crime punishable by law.
- i) Establish special courts to handle land-use problems.

Prevent desertification. Preventive projects regarding desertification: desertification is one of the most important causes of environmental deterioration, and is due to the disturbance of the environmental balance by natural and human factors. The danger of desertification is that it cannot be controlled after a certain phase. Studies show that land-productivity deterioration due to desertification is highest in the third area (marginal), followed by the second area (highlands). Therefore, efforts should be concentrated on these two areas because they contain the most productive agricultural lands. The problem should be dealt

⁶One dunum = 1,000 square meters, or 10 ares, or 0.1 hectare, or 0.247 acres.

with on the national rather than the governorate level, and any successful strategy to control desertification should emphasize the need to:

- Appreciate the comprehensiveness of the problem, which requires an internationally-integrated plan.
- Develop plant cover and control its deterioration.
- Decrease the effect of soil erosion and deterioration.
- Follow a clear policy for land use.
- Follow a development policy based on environmental protection criteria.
- Manage resources in a sound manner.

4.2 Protecting Soils

Soil preservation is one of the most important means to stop agricultural land deterioration, due to the effect it has on environmental pollution, since flowing surface waters carry pollutants which usually end up behind dams and get used in agriculture or else to replenish groundwater. Soil preservation requirements differ from one environmental area to the other, but emphasis should be given to the second and third areas, due to their direct impact on preserving the Jordanian environment.

Mountains. In the mountain highlands, soil preservation strategy should include the following:

- Adopt the principle of optimal land use.
- Stop ploughing on slopes.
- Introduce suitable ploughing techniques, especially in shallow lands.
- Implement suitable soil preservation projects.
- Protect highlands against over-grazing.
- Protect forests.
- Decrease grazing at harvest time.
- Implement projects which can help preserve soil humidity.

Marginal steppe. In the marginal steppe area, soil preservation strategy should include the adoption of these guidelines:

- Restrict ploughing except for targeted uses.
- Develop plant cover in specific areas (by replanting of specific types).
- Organize grazing and adopt specific grazing seasons.
- Protect lands of good productive capacity.
- Reconsider the policy of eastern land distribution (tribal lands).

4.3 Safeguarding Agricultural Land

Misuse of agricultural inputs. Legislation is required to control damaging practices such as burying insecticides or toxic material residuals, leaving them in the open air, or mixing them with water which eventually spreads onto agricultural land. The public should also be made aware of the dangers of such practices as dumping domestic wastes, in addition to the importance of using insecticides in specific concentrations and at certain times.

Population settlements. Determine sites of population settlements on the basis of specific environmental criteria in order to preserve land for agricultural use and to prevent construction expansion and other uses of agricultural land, taking into account the prevailing population/environmental balance in the area.

Integration of environmental elements. The environment is comprised of various components, most important of which are water, soil, climate, plants and people. The condition of any of these components affects the balance among them all. Therefore, laws for preserving the environment should take into account the interrelationship between these elements in order to give each of them appropriate emphasis.

Environmental legislation. Agricultural inputs such as plastic and insecticides are one of the reasons for soil quality deterioration. Insecticide residuals affect man through his

consumption of plant products. Therefore, it is imperative to draw up the necessary legislation to define timing and quantities of insecticides to be used, verify non-accumulation in the soil, manage use, verify standards before use, and establish a monitoring system for these issues.

Valuing "environment" in project appraisal. Projects to conserve land resources must be socially and environmentally feasible; economic feasibility can be achieved by conserving these resources for future generations. Projects to prevent erosion, conserve forests and re-grow plant cover all have long-term economic benefits as well as positive natural effects on the environment.

Economies of scale. Fragmented land ownership is one of the main reasons for land deterioration, as it leads to negligence and encourages the tendency of many people to practice agricultural activities in eastern areas which are of relatively low productive capacity. To deal with this phenomenon, the size of land ownership which can support a family must be defined in order to amalgamate smaller properties, in addition to defining the limit of large properties.

Suitable technology. It is necessary to develop systems and modern management techniques appropriate for local conditions, and to make sure that imported techniques are suitable for local conditions.

Development in distant areas. Development and agricultural projects should be used to attract areas by dividing new development areas into smaller units, using industrial centres as population pole centres, encouraging the establishment of more development projects to increase human resources, and working to achieve demographic re-distribution.

4.4 Water Resources

Water quality and waste water. Monitor water quality, especially waste and saline water, before using them for irrigation purposes. In this regard, legislation can be introduced to control the quantity of water extracted from wells to prevent salinization. Waste water should be used in areas close to treatment plants and for plant forage crops or any other crops which are not consumed directly by man. This water should not be mixed with good irrigation water as is the case in the Zarqa Valley.

Ensure that waste water which is to be used directly or mixed with other water, before being used for irrigation, meets international standards for similar areas or neighbouring areas which have implemented such standards.

Take necessary precautions before approving treatment plants and waste disposal sites. This can be achieved through field studies and research on proposed areas, comparing them with other areas that were used for this purpose, and studying the possibility of reusing wastes in industry.

Salinization. Determine water needs of various crops to avoid accumulation of minerals and salt which cause deterioration in some types of soil.

Exploit surface water more effectively through the adoption of better irrigation and water distribution networks, especially in the Ghor area. Pumping of groundwater should be limited to set levels, to prevent water and soil salinization due to over-extraction.

Consider the need to leach irrigated lands in order to maintain a low level of salinization and to obtain higher agricultural yields.

Drip irrigation. Adopt modern high-efficiency irrigation techniques, such as drip irrigation, which provide efficiency of over 90%, compared with surface water, which may reach 50%. Many studies carried out by the University of Jordan indicate that this would conserve water, expand the irrigated areas and thus double production.

Pollution by chemicals. Establish sanitary sewerage systems to avoid soil pollution by sewerage waste, especially in the Jordan Valley and water basins located within the boundaries of such sewerage projects.

Stop building open canals and surround existing ones with fences in order to decrease loss of water due to evaporation and to prevent pollution due to continued use of canals by farmers for washing and other purposes. Fencing will also control pollution from dumping wastes.

Treat pollution caused by agricultural pesticides and herbicides and prevent their seeping into groundwater. Control use of some chemicals which have long-term residuals through adequate environmental specifications. Studies on insecticides indicate the presence of harmful residuals in fruits consumed by human beings. Studies also show that there is a high level of nitrates in water due to increased use of fertilizers.

4.5 Climate

Conservation of the climate is the shared responsibility of all nations through co-operation and strict adherence to resolutions and recommendations issued by international organizations involved in the conservation of climate and environment. On the national level, attempts should be made to control factors leading to atmospheric depletion and pollution through the following procedures:

- Expand use of alternative energy and search for new sources which do not lead to atmospheric pollution.
- Rationalize consumption of hydrocarbon fuels and control atmospheric pollution from smoke.
- Protect marginal areas against desertification, stop environmental destruction processes, and maintain and improve plant cover.
- Initiate afforestation where conditions permit; conserve existing forests and re-forest denuded areas.
- Continue the artificial rain programme.
- Control use of chlorofluorocarbons in industry, and exploit forest and grazing plants which can tolerate drought.

4.6 Forest Resources

Assess natural and artificial forests in terms of area, distribution and wood assets in order to plan their use and management. Facilitate management by consolidating forest lands into appropriate management units.

Afforestation. Formulate a plan for afforestation of barren lands and government lands which are very steep, through the following steps:

- Mechanize afforestation.
- Adopt a national forestry programme comprising all official and unofficial sectors.
- Initiate suitable legislation that allows afforestation of private lands if they are neglected, very steep or of touristic value.
- Co-operate with the armed forces to afforest camps, forest lands and government lands.
- Co-operate with municipalities to plant barren lands within their boundaries. Co-operate with mining companies, like the phosphate and cement companies, to afforest mining areas after work in them is completed.
- Co-ordinate with the Jordan Valley Authority to plant trees in all saline lands and lands unsuitable for agriculture in the Jordan Valley and side valleys.
- Co-ordinate with the Water Authority to plant trees in areas polluted by waste water, and use waste water mainly to irrigate forest land.
- Provide financial and manpower needs to the Forestry Department to help it double the areas planted every year and to protect forests from trespassing and pollution.
- Carry out research to derive or import forest species which tolerate drought and which are suitable for forest land in harsh climatic and topographical zones.
- Organize the recreation facilities in forests and recreation areas to prevent their pollution and avoid dangers such as fires and other detrimental practices.

4.7 Grazing Resources

- Establish a clear grazing policy that defines natural grazing areas and links them to one agency responsible for systematic protection and management, to maintain a balance between environmental elements such as plants, animals and soil.
- Enforce the Agriculture Law concerning government or privately owned grazing areas, and ban ploughing and plant cover removal unless a continuous source of irrigation is available.
- Continue development, protection and sound scientific use of grazing lands in the manner adopted by the Forestry Department and the Co-operative Organization for establishing and managing grazing reserves.
- Provide a staff to develop grazing lands. Appoint extension staff to contact citizens living on grazing lands and inform them of the importance of developing these lands and of participating in the government's projects for this purpose.
- Increase forage production in rain-fed and irrigated lands, and ease pressure on grazing lands for a certain period of time to allow regrowth of plant cover.
- Formulate laws to regulate trans-boundary grazing operations.
- Develop range management technology and encourage small farmers to incorporate stock-breeding in their farms.
- Allow managed grazing in natural forest areas and in artificial forest areas of trees more than 15 years of age.

4.8 Animal Resources

- Carry out research and studies to produce animal breeds of high productivity and quality.
- Enforce legislation which bans slaughtering young and small animals.
- Provide forage and other requirements for animal production at reasonable prices, and expand natural grazing areas.
- Provide health and veterinary care and eradicate diseases passed between man and animal.
- Increase efficiency of animal production by sound management and modern techniques, in order to compete with imported animal products.
- Promote industrialization of forage and animal products and prevent pollution resulting from traditional manual techniques.

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ANNEX 1 – IUCN RECOMMENDATION ON LAND DEGRADATION⁷

Noting that there has been a dramatic increase over the past decade in the commitment of nations and the international community to the concept of sustainable development;

AWARE that it is now ten years since the publication of the World Conservation Strategy, that it is four years since the publication of the Report of the World Commission on Environment and Development, and that many countries have produced National Conservation Strategies;

RECOGNIZING that there is now widespread acceptance that conservation, sustainable development and the maintenance of habitats, genetic diversity and species cannot be accomplished only within the boundaries of formally designated protected areas but will depend heavily on appropriate measures outside those boundaries;

NOTING FURTHER that in most continents, land degradation, in its many facets, is one of the most important and serious threats to the attainment of sustainable development;

CONCERNED that land degradation is a major cause of deterioration of freshwater and marine environments;

REMARKING that many policy statements of a general nature have been made on the need to prevent land degradation, but that specific methods to allow landowners to measure land degradation have generally not been developed;

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

STRONGLY RECOMMENDS to national governments, funding agencies, international land-use and conservation organizations as well as national and provincial land-use and conservation organizations that:

- a. greatly increased attention and funding be provided to the study of those land-use practices that contribute to land degradation and development of practices that promote sustainable land-use;
- b. specific research be directed towards the identification and development of simple procedures and parameters by which land degradation can be identified and measured;
- c. education and extension programmes for land-owners and users be developed at all levels of government;
- d. landowners and users be involved to the maximum extent practicable in these research, monitoring, education and extension programmes;
- e. fiscal and taxation measures be developed and applied to encourage and assist landowners and users to apply the results of the above activities.

⁷Source: resolution 19.23 of Resolutions & Recommendations from the 18th Session of the General Assembly of IUCN-The World Conservation Union, Perth, Australia, Dec. 1991.

ANNEX 2 - INFORMATION ON WORKING GROUP

A-2.1 Names and Current Affiliations of Committee Members

Name and Title	Affiliation
Dr. Sami Sunna (Chairman, Undersecretary)	Ministry of Agriculture
Dr. Suleiman Arabeiyat (Dean, Faculty of Agriculture)	University of Jordan
Eng. Muzahem El Mheisen (Dir., Town Planning Dept.)	MMRA&E
Mr. Husam Azar (Dir., Statistics and Public Relations)	Dept. of Lands and Survey
Eng. Faisal Zureikat (Dir., Remote Sensing Project)	Royal Geographic Centre
Eng. Hashem Sboul (Dir., Operation and Maintenance)	Jordan Valley Authority
Eng. Mohammad Tawil (General Manager, Farmers Union)	Farmers Union, Jordan Valley
Eng. Abdulla Abu Hammad (Deputy Director)	Agricultural Credit Corp.
Dr. Saleh Share' (Assistant Director, Dept. of Environment)	MMRA&E
Dr. Anwar Battikhi (Head, Soil and Irrigation Dept.)	University of Jordan
Dr. Awni Tu'aimeh (Professor, Soil)	University of Jordan
Eng. Abdel Mu'ti Tellawi (Head, Planning and Studies Sec.)	Ministry of Agriculture
Dr. Yousef Shuraiqi (Head, Centre for Analyzing Insecticides/Residues)	Ministry of Agriculture
Eng. Ibrahim El-Atawi (Head, Climate Section)	Meteorological Dept.
Eng. In'am Tahboub (Head, Scientific Research Centre)	Meteorological Dept.
Eng. Abdel Majid Abu Rumman (Dir., Balqa Agriculture Dept.)	Agricultural Engineers Union
Dr. Kamal Tadrus (Head, Range Research Sec.)	Ministry of Agriculture
Eng. Muhammad Awamleh (Head, Marketing Consulting Sec.)	Agricultural Marketing Corp.
Eng. Baker Qudah (Head, Soil Survey Sec.)	Ministry of Agriculture
Dr. Nasim Barham (Associate Professor, Geography Dept.)	University of Jordan

Eng. Karima Ghanem (Union Director)	Agric. Commodities Traders Union
Eng. Nisreen Mazahreh (Researcher, Studies and Statistics Sec.)	Ministry of Supply
Eng. Yasin Zu'bi (Land Protection Specialist, Dept. of Env.)	MMRA&E
Eng. Munzer Kharraz (Irrigation Specialist)	Ministry of Agriculture

A-2.2 On-Call Members

Name and Title	Affiliation
Eng. Mahmoud Junaidi (Forests and Ranges)	Private sector
Dr. Abdel Rahim Telli (Soil and Forests)	Jordan Valley Authority
Mr. Badri Mulqi (Lands)	Lands and Survey Dept.
Dr. Ali Abandah (Meteorology)	Meteorological Dept.
Dr. Amin Kara'in (Meteorology)	Meteorological Dept.
Eng. Amjad Rihani (Soil Survey)	Ministry of Agriculture
Eng. Oadis Serbekian (Irrigation)	Jordan Valley Authority
Dr. Walid Abed Rabbo (Rural Development)	Ministry of Agriculture
Eng. Muhammad Qablan (Agricultural Statistics)	Ministry of Agriculture
Dr. Rasmi Suwaiti (Agricultural Economics)	Ministry of Agriculture
Eng. Jamil Hijazi (City Planning)	Jordan Valley Authority

ANNEX 5 – KEY SOURCES OF SECTORAL INFORMATION

A-3.1 Specialists in Agriculture and Land Sector

Name and Title	Affiliation
Dr. Anwar Battikhi (Soil and Irrigation)	University of Jordan, Faculty of Agriculture
Dr. Sami Sunna (Agriculture)	Ministry of Agriculture
Eng. Hashem Shoul (Irrigation)	Jordan Valley Authority
Dr. Awni Tu'aimeh (Soil, Climate and Land Use)	University of Jordan, Faculty of Agriculture
Eng. Abdel Mu'ti Tellawi (Forests and Ranges)	Ministry of Agriculture
Dr. Kamal Tadrus (Ranges)	Ministry of Agriculture
Eng. Yasin Zu'bi (Land and Environmental Protection)	MMRA&E
Eng. Khalaf Al-Oqleh (Protection and Environment)	MMRA&E
Dr. Saleh Share' (Forests)	MMRA&E
Eng. Munzer Kharraz (Irrigation)	Ministry of Agriculture
Eng. Oadis Serbekian (Irrigation)	Jordan Valley Authority
Eng. Mahmoud Junaidi (Forests and Ranges)	Private sector
Dr. Abdel Rahim Telli (Forests and Soil)	Jordan Valley Authority
Eng. Baker Qudah (Soil Survey)	Ministry of Agriculture
Eng. Amjad Rihani (Soil Survey)	Ministry of Agriculture
Mr. Husam Azar (Land-use Laws)	Lands and Survey Dept.
Eng. Mzahem El-Mheisen (Regional Planning)	MMRA&E
Eng. Faisal Zureikat (Resource Assessment)	Royal Geographic Centre
Dr. Nasim Barham (Land Use, Social Aspect)	University of Jordan
Eng. Ibrahim Atawi (Climate and Meteorology)	Meteorological Department

Dr. Ali Abandah (Meteorology)	Meteorological Department
Dr. Amin Kara'in (Meteorology)	Meteorological Department
Dr. Yousef Shureiqi (Insecticides)	Ministry of Agriculture
Dr. Walid Abed Rabbo (Rural Development)	Ministry of Agriculture
Dr. Suleiman Arabeiyat (Agricultural Economics)	University of Jordan
Eng. Maher Abu Ja'far (National Parks)	Royal Society for the Conservation of Nature
Eng. Ir'am Tahboub (Agricultural Climate)	Meteorological Department
Eng. Mahmoud Abdel Ghani (Agricultural Meteorology)	Meteorological Department
Mr. Badri El-Mulqi (Land)	Lands and Survey Department
Eng. Mahmoud Abu Sitteh (Ranges)	Ministry of Agriculture
Dr. Salem El-Lawzi (Land Use)	Prime Ministry
Dr. Subhi El-Qasim (Agriculture and Environment)	University of Jordan
Dr. Muhammad Khaled (Animal Resources)	Ministry of Agriculture
Dr. Muhammad Harb (Animal Resources)	Univ. of Jordan, Faculty of Agriculture
Dr. Sudqi Khader (Soil)	Univ. of Jordan, Faculty of Agriculture
Dr. Aved Omari (Forests)	Ministry of Agriculture
Dr. Mahfouz Abu Zant (Grazing Lands)	University of Jordan
Dr. Ibrahim Nazer (Soil Conservation)	University of Jordan
Dr. Butrus Hattar (Soil Fertility)	University of Jordan
Dr. Said Khatari (Soil Nutrition)	University of Jordan
Dr. Deib 'Wais (Irrigation Engineering)	University of Jordan
Mr. Shehadeh El-Azzeh (National Parks)	Ministry of Tourism
Dr. Ibrahim Ghawi (Soil Physics)	University of Jordan
Dr. Daifalla Badarneh (Soil Micro-organisms)	University of Jordan

Dr. Ibrahim Saket (Soil Chemistry)	University of Jordan
Dr. Yousef Rushdi (Vegetables)	Ministry of Agriculture
Dr. Barakat Abu Rumeileh (Weed Control)	University of Jordan
Dr. Muhammad Shatnawi (Irrigation Engineering)	University of Jordan
Dr. Na'im Sharaf (Insects)	Ministry of Agriculture
Dr. Tawfiq Mustafa (Plant Protection)	University of Jordan
Dr. Abdulla Al-Musa (Plant Protection)	University of Jordan
Dr. Walid Abu Gharbiyeh	University of Jordan
Dr. Hussein Al-Musa (Insect Control)	University of Jordan
Mr. Thabit 'Alawi (Insect Control)	University of Jordan
Mr. Mazen Akkawi (Plant Protection)	University of Jordan
Mr. Ahmad Raddad Al-Musa (Plant Protection)	University of Jordan
Mr. Nazim Abu Rub (Soil Fertility)	Ministry of Agriculture
Mr. Naji Haddadin (Soil)	Ministry of Agriculture
Mr. Khaled Masannat (Protection)	Ministry of Agriculture
Dr. Hifzi Abu Bilal (Protection)	University of Jordan
Dr. Taleb Abu Sharar (Soil Chemistry)	University of Jordan
Mr. Azzam Muheisen (Forests)	Ministry of Agriculture

A-3.2 National Institutions in Agriculture and Land Resources

- Department of Environment, Ministry of Municipal, Rural Affairs & the Environment, Amman.
- Forestry and Soil Preservation Dept., Min. of Agric., Kamaleiyeh, Sweileh, Amman.
- Ministry of Agriculture, Amman.
- Royal Society for the Conservation of Nature, Jabal Amman, Amman.
- Jordanian Society for the Control of Environmental Pollution, Amman.
- Faculty of Agriculture, University of Jordan, Amman.
- Yarmouk University, Irbid.
- Jordan University of Science and Technology, Irbid.
- National Centre for Research and Technology Transfer, Min. of Agriculture, Baq'a.
- Water Authority, Ministry of Water and Irrigation, Amman.

- Jordan Valley Authority, Ministry of Water and Irrigation, Amman.
- Lands and Survey Department, Amman.
- Natural Resources Authority, Amman.
- Toxicity Centre, Ministry of Agriculture, Baq'a.
- Royal Geographic Centre, Amman.
- General Statistics Department, Amman.
- Arab Centre for Studies on Arid and Dry Areas (ACSAD), Damascus (Syria-Jordan).
- International Centre for Agricultural Research in Dry Areas (ICARDA), Aleppo.
- Arab Organization for Agricultural Development, Khartoum, Sudan.
- FAO, Rome, Italy.
- UNEP, Nairobi, Kenya-Jordan office.
- Royal Scientific Society, Amman.
- Farmers Union, Jordan Valley.

3 • Surface & Groundwater⁸

1 CURRENT STATUS OF WATER IN JORDAN

All issues related to the water sector seem to be of high priority, due to the importance of this sector. However, the principal priority is to discover and increase the supply of water, as demand has out-stripped it.

1.1 Available Supply

Water Resources include all surface and groundwater resources and non-traditional water resources which is treated plant effluent. (See Table 1, Annex 1).

Groundwater. This refers to quantities of available renewable groundwater resources (safe extraction) were estimated at 280 Mm³ annually for water strata that have been examined to date from all basins (12 basins). Quantities of available non-renewable groundwater (which has no re-charge) were estimated at 118 Mm³ over a period of 100 years. These sources are found in the Disi-Mudawwara area and the Shadiya area in the Jafer Basin.

Total available groundwater quantities = 398 Mm³ annually.

Surface water. This refers to river water, stream discharge, flowing valleys and flood water in winter. Surface water quantities are estimated at around 755 Mm³, more than half of which is in the Yarmouk River Basin (411 Mm³ annually). The rest is distributed throughout other basins throughout the country. Surface water is plentiful in the north and west of Jordan and scarce in the south and east.

Non-traditional water. This refers to treated water from waste treatment plants. Quantities were estimated at 32 Mm³ in 1989, and are expected to increase to 60 Mm³ in 1995.

1.2 Water Consumption

Consumption represents quantities of water used from all sources for all purposes. (See Table 2, Annex 1). The total quantity of water consumed for all purposes in 1989 reached 961 Mm³, 430 Mm³ of which came from groundwater sources, and 530 Mm³ from surface water; treated water was estimated at 32 Mm³ in 1989, 90% of which flows from the Khirbet Samra treatment plant. Total discharge for all treatment plants is estimated to reach 60 Mm³ annually by 1995. An estimated 97% of the population is served by water provision networks, and 54% of the total population is served by sewerage treatment networks.

Water is primarily used for irrigation, domestic and industrial purposes as detailed below.

Irrigation. This represents all water used for irrigating plants (trees, vegetables, crops, forage and cattle watering). The quantity of water used for irrigation purposes from all water sources was estimated at 764 Mm³ in 1989, 264 Mm³ of which came from groundwater and 500 Mm³ from surface water sources. Most of the surface water used for irrigation (460 Mm³) is consumed in the north and central Ghor areas. Most of the groundwater used is consumed in desert areas.

Domestic and industrial uses. This represents all water used in houses, gardens and all types of industries. Quantities of water used for this purpose were estimated at 197 Mm³ in 1989, 165 Mm³ of which came from groundwater and 32 Mm³ from springs. Most of this

⁸Information in this chapter was prepared by the Water Committee, under the chairmanship of Eng. Mutāzz Belbeisi, Secretary-General, Ministry of Water & Irrigation.

water is consumed in Amman and other main cities (Irbid, Zarqa, Karak, Aqaba), due to the high living standards and high population density found there.

1.3 Net Deficit

We can conclude the following by comparing water availability with consumption (Tables 1 and 2, Annex 1):

- There is an annual deficit in renewable groundwater of more than 90 Mm³ due to the depletion of the main water basins.
- More than 45 Mm³ of non-renewable groundwater can be extracted annually (within the proposed extraction programme) by digging new wells in the Disi-Mudawwara area. There is a surplus of surface water of 336 Mm³ annually, most of which (203 Mm³/yr) comes from the Yarmouk River. The rest is flood water distributed throughout the remaining water basins.

1.4 Main Groundwater Basins for Future Exploitation

Groundwater. Groundwater in un-studied and unused aquifers and basins: (i) groundwater in deep sand aquifers, except for Disi Basin; (ii) Hammad Basin area; (iii) Sarhan Basin area. No hydrological studies for these areas have been conducted due to their distance from population settlements and the low demand for water. With respect to saline water, no serious study has yet been conducted to investigate desalinization of saline groundwaters, due to the high cost of such an undertaking, in addition to the fact that their quantities and locations have not yet been studied.

Rain and surface water. There is potential for this water to be stored in dams: more than 330 Mm³ of surface-flowing waters and floods discharge into the Dead Sea without being used because there are not enough dams to hold them.

Also, there are problems in collecting rain-water in collecting wells and reservoirs; people in the countryside become reluctant to use water from collection wells once they start receiving water from the national network. Also, people in large urban centres do not have collection tanks for rainwater which could be used for private gardens.

Desert dams and desert pools. Desert rains are characterized by their high intensity and short duration, which lead to torrential floods and stream run-off. Building desert dams and trenches would retain some of these waters, which could be used in the summer for watering cattle and in other agricultural activities.

2 ISSUES OF WATER AVAILABILITY AND CONSUMPTION

2.1 Water Sources

Limited sources of water (present and future). Climatic conditions and geographic position affect water sources directly; 75% of the Kingdom's lands are desert areas; and the cost of developing some water sources like Karama Dam are prohibitive. The indecision regarding other possible sources, like Wehda Dam, has forestalled action to date.

In addition, several evaluation studies were conducted to evaluate water sources, but they were incomplete.

Resource depletion. Depletion of some water sources and concentrated exploitation of some main groundwater basins (Amman-Zarqa, Azraq) have led to the depletion of their water reserves, since water sources in the extraction areas are not replenished.

Depletion of groundwater and traditional irrigation methods (open canals) have led to the deterioration of groundwater quality in the Dhuleil area, where the salinization level increased from 300 ppm to 3500 ppm, and the nitrate concentration increased to 70 ppm.

Discharge of industrial wastes of all kinds without treatment in the Amman area has caused groundwater pollution in the upper strata, with all types of organic and chemical pollution.

Factors of distance and high cost. The distance between most water sources and the areas of consumption is excessive, for example in Amman, Zarqa and Irbid.

There is a high cost for water extraction and transfer to consumption areas. For example, water is pumped to Amman from wells from Qatrana, Siwaqa, Qastal and Azraq. Expenses for digging wells, in addition to the cost of distribution, and operation and maintenance, all contribute to the high cost of delivering water from production to consumption areas.

Problems with resource protection. There is need to protect surface and groundwater sources from pollution. Surface and groundwater in many basins in the country has been subject to pollution. There has been groundwater pollution from organic and industrial pollutants in the Amman, Zarqa, and Dhuleil areas, and surface water pollution in King Talal Dam and King Abdullah Canal. There is also over-extraction from most groundwater fields.

Vandalism of facilities occurs. Many water distribution lines in remote areas are subject to being shot at by shepherds and vandals in order to get a small quantity of water. Monitoring and detection equipment distributed around the country is also subject to occasional breakdown.

Water harvesting. At the present time, there is no integrated plan to make use of rain-water in desert areas by building dams and desert pools, although some exist in eastern areas, as in the Hammad Basin.

Artificial groundwater re-charge. Some dams were established at Qatrana, Aqeb, Shu'aib, to re-charge groundwater but they are not enough. More dams have to be built in areas where groundwater has been depleted, such as the northern *Badia* and Shobak areas.

Researching desalinization. There is a need to conduct studies of desalinization of sea and brackish groundwater, and to prepare technical staff with practical expertise in this field.

Licences. An existing groundwater-control regulation specifies the process of giving drilling licences to the private sector. All stipulations of the regulation are implemented, except for the one that deals with extraction licences, due to the difficulty of controlling it. This area of non-compliance needs to be rectified.

Water losses. It is necessary to decrease the loss of water from the King Abdullah Canal and its tributaries and to protect it from pollution. Quantities of canal water leak through cracks, lost animals fall into the water, and wastes are thrown into it.

Incompatible land uses. Establishing factories and housing compounds in areas of groundwater re-charge, as is the case of the Amman area, results in declining water quality.

Water analyses. There is a need to unify methods of preparing and analyzing water samples. Various agencies, among them the Water Authority, Ministry of Health, and RSS, collect, prepare, and analyze water samples from their sources and consumption areas. Each agency has its own method for preparing and analyzing samples, which leads to differences in evaluating the results.

2.2 Issues of Water Use

Water allocation policy. There is severe competition for water. The absence of a clear policy for allocating water use has resulted in scarcity and competition by the following sub-sectors:

Potable:	representing 20% of total water consumed
Irrigation:	representing 79% of total water consumed
Industry:	representing 01% of total water consumed

Water quality standards. Water quality standards need to be defined for various uses, especially in agriculture.

Water inefficiencies and interruptions. There are a number of issues related to improving efficiency of water use systems:

- Potable: decrease loss in the network by changing old pipes.
- Irrigation: maintain irrigation canals and use modern techniques.
- Industry: study the possibility of recycling water, especially in industries that consume large quantities of water (phosphate washing, for example).
- Rationalize consumption of water for all types of use.

Also, water provision is irregular and interrupted which affects all users. Adverse consequences are:

- Interrupted and irregular provision of potable water can damage the network, leading to water pollution. Consumers also store more water than actually needed and use it for no planned purpose.
- Irregular irrigation of plants adversely affects the quality and quantity of crops.

Rising demand. Demand for all purposes continues to increase:

- Potable, due to high population growth in Jordan (3.6% annually); and rising living standards of the population, especially in main urban centres which contain more than 80% of the Kingdom's population.
- Irrigation: there is continuous expansion of irrigated agricultural lands, accompanied by an increase in levels of water consumption.
- Industry: the industrial sector has become very active in recent years, causing a steady increase in water consumption.

3 WATER POLLUTION AND MANAGEMENT ISSUES

3.1 Wastewater

The handling or mis-handling of wastewater is of increasing concern in Jordan. There are a number of issues which relate to performance of sewage treatment plants, the system networks, and the types of influent and effluent:

- Completing sewerage system networks and treatment plants is necessary to preserve surface and groundwater and the environment, and also enables treated water to be used for agriculture.
- Complete the establishment of treatment plants for factories, and ensure that their methods of operation and discharge are safe for the environment.
- Set standards of quality according to intended uses of water produced by treatment plants; at present no specifications regulate this area.
- Link buildings which are close to and ready to be connected to sewerage system networks, in order to decrease groundwater pollution and increase the quantity of water to be recycled by treatment plants.
- Liquids produced by olive presses have an adverse effect on water resources.
- Separation of oils and chemicals in automotive service stations has an adverse effect on the operation of sewerage treatment plants.
- Reuse sludge produced by treatment plants as organic fertilizers in agriculture.
- Cesspools and their detrimental effect on groundwater through leakage (Ma'an, Zarqa, Amman and others).

Problems Related to Waste Water Treatment

Waste water treatment requires a particular level of skilled personnel who are familiar with the state-of-the-art of efficiently planning, designing, operating, maintaining and managing a successful waste water system. Jordan has a significant number of qualified engineers who can form the base for the needed skills, but they lack training in teamwork methodology. Adequate training in the field of appropriate operation and maintenance technology is a feasible solution to the problem of skills required for operating and maintaining the systems.

Plant loading and the characteristics of influent are major factors that affect efficiency. Overloading (hydraulic/biological) deteriorates the quality of the waste water effluent and produces objectionable odours. Jerash, Salt and Samra plants are biologically and/or hydraulically overloaded. The Samra plant produces objectionable odours in its neighbourhood.

Most of the detergents that are used in Jordan are hard and thus reduce the efficiency of waste water treatment plants. The effect of such detergents are toxicity, environmental impact and process interference. Hard detergents may hinder the aerobic function of the ponds by a factor of three and sludge digestion in the anaerobic ponds could be reduced by detergents. The ideal solution to the hard detergent problem is to use soft detergents (biodegradable). To this effect, the Ministry of Trade and Industry is considering banning the manufacture of hard detergents.

Water Quality. Numerous agencies have claimed direct or indirect responsibility for monitoring water and waste water quality. This situation has had a negative impact and has led to a dilution of responsibility, inefficiency and duplication of effort. The assumption of responsibilities by irresponsible volunteers in this national matter has resulted in the undeserved criticism of operating agencies. Therefore, monitoring of water and waste water quality should be assumed by one central agency which should co-operate and co-ordinate with the various agencies that are involved in the field of environment and human health.

Jordan groundwater resources are generally of good quality. This is attributed to the phenomenon that these resources have a high rate of annual re-charge. However, there are many potential sources of contamination of surface and groundwater. Some of these sources are industrial and municipal wastes, excessive use of pesticides and chemical fertilizers in agriculture, and over-pumping that may lead to the intrusion of saline water in certain aquifers.

The Zarqa River is contaminated by industrial waste that includes trace elements and heavy metals. Mercury, nickel, arsenic, lead, selenium and cadmium are the main pollutants of the Zarqa River and the King Talal Reservoir (KTR) which is constructed on it. Also, waste water effluent from the Khirbet Samra Treatment Plant is discharged to the Zarqa River. Industrial waste water eligible to be discharged in rivers must comply with the stringent Standards Specifications No. 202. However, these specifications are not applied and subsequently, the Zarqa River and King Talal Reservoir are heavily polluted. Based on experimental work carried out in London, it is advised that under no circumstances should KTR be used for potable water, unless substantial improvements are made to upgrade the raw water quality.

The Jordan River is highly saline because all on-shore saline and brackish springs were diverted around Lake Tiberias to the Jordan River; it also receives return flow from irrigated fields and is not suitable for any use in its present condition. Water of the Dead Sea is highly saline and, therefore, is not suitable for irrigation or domestic use.

The quality of the Yarmouk River is acceptable at present. Due to the discharge of Ramtha Wastewater Treatment Plant effluent into the Yarmouk River, its water quality could change and thus should be monitored. Programmed monitoring of the water quality of all major rivers and wadis of Jordan is needed, because the effluent of 12 waste water treatment plants is discharged into those rivers or wadis.

– Abdallah Ahmad

Jordan Environmental Profile-Status and Abatement.

3.2 Other Problems

1) Modify and set the following types of performance specifications:

- Sewerage systems and waste water of all non-industrial activities; specifications should be set according to the intended use of the water produced by sewerage system plants.
- Conditions of factories connected to the public sewerage system. Factory effluent requires pre-treatment.
- Crops should be suitable for the quality and quantity of available water.
- Water used in fisheries.

2) Disposal sites:

- Domestic wastes: certain locations have been used by some municipalities as disposal sites for domestic solid wastes without previous studies of site suitability. This has led to surface and groundwater pollution, as is the case at the old disposal site in Amman.
- Industrial wastes: no designated sites for this purpose at present.
- Hazardous wastes: a site east of Qatrana was selected. Analysis and implementation procedures should be completed for the site.
- Disposal of slaughterhouse wastes in domestic disposal sites is a harmful practice.

3) Fertilizers and insecticides: due to lack of awareness among farmers, overuse of fertilizers and insecticides occurs frequently and has led to soil and water pollution, especially in the Ghor areas.

4) Integrated environmental assessment of water and water-related projects has not been considered in previous projects.

5) Environmental education and information: the environment has not received the necessary attention in school curricula and various media.

6) Co-ordination with neighbouring areas: scarcity of water resources in the area and increasing demand on them have created a critical situation requiring co-ordination with neighbouring countries sharing water resources for example, Saudi Arabia for Disi waters, and Syria for the Yarmouk River.

7) Weak financial and moral support for the Jordanian Society for the Control of Environmental Pollution hampers its efforts on environmental issues, although as a new society it has made an impressive start.

8) Lack of incentives to reuse water in industry.

3.3 Financial & Economic

1) Water tariff levels should be set in line with the costs to the government of providing the service and should also take into account the income of the consumer. A special tariff should be imposed for water extracted from private wells used for agriculture and industry.

2) Studies are needed on the economic, technical and social feasibility of all water and sewerage system projects, and especially their environmental aspects.

3) Finance studies to deal with the environmental impacts of standing water projects, especially the uses of King Talal Dam water and their effect on man, animals, plants and soil.

4) Finance water and sewerage system projects.

5) Non-availability of water for future industries is an emerging issue, due to the continuous increase in demand for surface and groundwater resources for irrigation and domestic use, and the scarcity of these resources. Note that the scarcity of water resources will be a defining factor in development planning for Jordan.

6) There is a lack of incentives to use recycled water.

7) Studies, research and development in the fields of water resources and quality is urgently required.

3.4 Management

- Integrate an environmental impact assessment into the economic feasibility studies for projects.
- Manage water resources by adopting a clear policy for water uses in all fields.
- Develop environmental awareness about the water sector through school curricula and other means.
- Consider regional planning in the economic development phases, taking into account the water balance.

3.5 Legislative

There are many laws and regulations, from various agencies, which control the water sector and the environment in the following fields:

- Licencing of industries is the responsibility of the Ministry of Industry and Trade.
- Defining, updating and issuing standards of water quality for the following uses:
 - potable
 - industry
 - fisheries
 - bottling
 - treatment plants' effluent
 - filling swimming pools
 - recreational purposes
- Preventing health hazards and penalizing violators of health regulations.
- Occupancy permits regarding buildings and their connection to the public sewerage system and digging ground wells.
- Haphazard disposal of wastes should be controlled and violators should be punished.
- Implementing legislation and regulations of all concerned agencies through specialized follow-up staff.
- Updating legislation in light of new events and developments.
- There is still no comprehensive environmental law for protecting Jordan's environment and it is urgently needed.

3.6 Land Use Conflicts

Facilities and settlements are incompatible with sites of groundwater re-charge. Many housing projects and industries are established on sites of groundwater re-charge, such as the case in Amman, or at sites where groundwater which is close to the earth's surface is extracted, as is the case in Azraq and Ma'an water pollution can occur.

4 OVERALL ASSESSMENT OF WATER SECTOR RESOURCES

4.1 Current & Future Trends

Some water sources in the Kingdom are subject to depletion, deterioration, and negative changes in water quality due to over-pumping and industrial pollution of the sewerage system and treatment plant effluent, and certain agricultural practices. To control such factors in the future, treatment plants for industries should be established, sewerage system networks should be used, and treatment plants must be made more efficient. Other steps are to control the use of fertilizers and insecticides, ban drilling in some areas, extract additional groundwater from deep strata, and develop qualitative and quantitative definitions for various water uses.

4.2 Results Affecting Development Prospects in Jordan

Water resources should be conserved and used efficiently since scarcity of these resources will be a determining factor in future development plans. Managing the demand resulting from population growth and depletion of water basins is an issue that requires regional co-operation in order to make best use of common water resources. Financing should be provided to support future development and conservation measures.

5 CAUSES OF DEPLETION AND DEGRADATION OF WATER RESOURCES

5.1 List of Practices and Pressures Affecting Water Resources

- Scarcity of water resources: available groundwater does not exceed 400 Mm³/yr, and available surface water does not exceed 530 Mm³/yr. In 1989, however, the demand for water exceeded 960 Mm³. The supply of water is limited, whereas the demand for it is continuously increasing.
- Over-extraction of water: emphasis on using groundwater has led to the depletion of the most important main basins at Amman, Zarqa, Azraq, Yarmouk, and others.
- Absence of a coherent water policy has led to the depletion and degradation of water sources, especially water used in the agricultural sector. Water-resource management cannot be applied without a clear water policy.
- Competition for water for various use categories —domestic, potable, irrigation and industry— is increasing, yet without defining limits for each.
- Untreated effluent emanating from various industrial factories pollute water resources of the Zarqa River Basin, the Zarqa River and further downstream at the King Talal Reservoir. Reservoir water contains bacteria and chemical pollutants as well as toxic metals in the sediments. The damage caused to irrigated crops in the Jordan Valley has been ascribed to the poor quality of water from the King Talal Reservoir, although scientific studies must verify the causal agents.

Problem Industries in the Zarqa Basin

The government identified a number of factories causing water quality problems in the Zarqa River Basin due to poor environmental management (June 1991). The factories represent a broad range of manufacturing activity, which suggests that technical fixes must be tailored to each type of enterprise. Factories are engaged in the manufacture of iron and steel, pipes, chemicals, intermediate petrochemicals, sulphochemicals, matches, paints, agriculture, food and yeast production, poultry, dairy products, ice cream, distilleries, blankets, paper and cardboard, and leather tanning. Automotive repair facilities and battery repair shops are also located in the area.

- Due to the lack of funding for water development projects, deep-water strata in most areas of the Kingdom have yet to be investigated. Their productive capacities and water quality remain unknown.

5.2 Socio-Economic and Political Aspects of Water Management

Beyond the physical limitation and scarcity of water resources, there are other socio-economic and political factors which exacerbate the water problem in Jordan:

- The concentration of industries in certain water basins. Most water-consuming industries in Jordan are concentrated in the Amman-Zarqa Basin, due to the availability of workers in this area. The fertiliser industry is concentrated in the Dead Sea Basin, the site of phosphate and potash mines (Hasa, Wadi Abyad, the Arab Potash Co.).

- Housing settlements and rapid and continuous urban development. More than 52% of the Kingdom's population lives in Amman and Zarqa and consumes more than 100 Mm³/yr for potable and domestic uses. Continuous and rapid urban development further increase the demand for water.
- Population migration: migration of citizens from rural to urban areas and forced immigration from outside the Kingdom increase the rate of water consumption for all purposes. For example, in 1991 200,000 Jordanian returned from the Gulf States as a result of the Gulf crisis.
- High population growth: Jordan's high population growth rate of more than 3.6%/yr results in increasing water consumption.
- Using water without co-ordination at the local level; each sector of water use makes its own plans without co-ordinating with other sectors.
- Using common water without prior coordination with neighbouring countries, which is the situation at Disi Basin (with Saudi Arabia) and the Yarmouk River and its tributaries (with Syria).

5.3 List of Obstacles to Sustainable Use of Water

- Scarcity of water resources.
- Increased demand on water for various purposes.
- Pollutants of all kinds.
- Water lost in potable and irrigation distribution networks, due to worn-out pipes and cracks in the King Abdullah Canal.
- Excessive distance of water sources from areas of water consumption; for example, Amman's water comes from a source 100 kilometres away at Azraq.
- Absence of information and awareness programmes about water conservation.

6 RECOMMENDED ACTIONS TO SOLVE WATER SECTOR PROBLEMS

Objectives of a sustainable water strategy for the year 2005 are:

- Provide sufficient healthful potable water for all residents.
- Provide suitable sewerage system services.
- Draw up a timetable of alternatives to implement such a system.
- Provide water for irrigation and industry from available resources.

The recommended actions are comprehensive and relate to every aspect of water: institutional changes, data-handling, research, planning, legislation, public involvement, and conservation.

6.1 Institutional Organization

- Study the organizational structure of government agencies working in the water sector and organize the relationships between them, defining the duties and responsibilities of each.
- Study the organizational structure of agencies involved in pollution monitoring, to define their relationships and responsibilities in order to avoid duplication.
- Study the organizational structure of agencies to define job descriptions, duties and responsibilities of each job and the required qualifications for each.
- Create a specialized framework within the Ministry of Water and Irrigation to study and evaluate water resources, draw up plans, and develop water policies and strategies and update them.
- Activate the role of national scientific agencies to carry out research and studies in water fields.

6.2 Information

- Prepare a unified list (in Arabic and English) of measuring units and terms used in water and pollution activities and circulate it to all concerned agencies.
- Issue regular pamphlets and specialized literature in the field of water.
- Organize all information relating to water in a water data bank for easy reference for studies, evaluation and planning, and issue an annual report containing information about the following:
 - a) Surface water (rain, surface flow, streams, discharge and dams).
 - b) Groundwater for all basins and water strata (re-charge, extraction and fluctuation of water level).
 - c) Use (potable networks, consumption patterns).
 - d) Treated waste water.
 - e) Climate (temperature, evaporation, humidity, winds).

6.3 Research Studies and Development

This phase requires action to:

- Carry out an integrated epidemic study on the reuse of treatment plant products in all treatment techniques.
- Study the matter of issuing standards in designing natural treatment plants which take into account local, environmental, economic and social conditions.
- Study the suitability of anaerobic treatment in Jordan.
- Study the effect of interrupted pumping in potable networks on the quality of water and the quantity of consumption.
- Study the technical, social, economic and environmental feasibility of using the following water sources for potable, industrial and agricultural purposes:
 - a) Desalinization of saline groundwater.
 - b) Desalinization of sea water.
 - c) Inter-country transfer and treatment of water (political aspects).
 - d) Artificial rain.
 - e) Re-use of treated water for industry and agriculture.
- Study economic and social feasibility of using water for low-yield crops in areas of limited water resources.
- Study water quality in dams, the existing sources of pollution, and their effect on man and the environment.
- Study the effects of waste disposal sites on water resources.
- Issue an integrated practical methodology for regular monitoring and evaluation of water quality in all sources.
- Study actual water needs for agricultural crops in all parts of Jordan.
- Carry out a comprehensive study to define the degree to which thermal hot springs can be used.
- Carry out a statistical study to show capabilities of people working in the field of water and pollution and to define any required training.

6.4 Planning

- a) Draw up long-term water strategies (not less than 15 years), which can be used to derive policies, projects and strategies within the elements of the NES.
- b) Update the National Water Master Plan (1977) and develop it annually to suit current conditions; assess quantity and quality of current and future water resources, and set suitable alternatives to achieve objectives from local and external resources.
- c) Formulate a programme to finance the plan and suitable alternatives and the possible funding resources, and give the water sector priority in government funding.

d) Set a formula for the maximum limit of individual consumption for potable water, and for agriculture (per dunum); increase the tariff significantly after the maximum level to promote efficiency and rationalization; i.e., plan for emergencies.

e) Formulate a comprehensive plan for water harvesting activities that would include building dams in the main valleys and desert areas, in addition to digging trenches.

f) Study the possibility of using saline water for various purposes after defining quantity and quality of various sources.

g) Define quantities for safe extraction of groundwater, and organize extraction.

h) Organize and complete detailed charts of water and sewerage system networks for each city and village to suit operation and maintenance requirements.

i) Formulate a plan to control depletion; create legislation and penalties to control negative practices by the private sector; revise organizational legislation.

j) Formulate a plan to complete the infrastructure of water-quality laboratories to meet the needs of required standards and specifications.

k) Complete procedures to realize specifications for potable water.

6.5 Environmental Impact Assessment

Development projects should include EIAs, indicating planning, design and implementation phases and emphasizing social and economic aspects.

6.6 Specifications

- Develop and issue standard specifications in all fields of use.
- Issue environmental standards for selecting and designing liquid and solid waste disposal sites and for their management and operation techniques.
- Develop and issue technical specifications to implement water and sewerage system projects.

6.7 Legislation

- Issue suitable legislation to preserve water resources in Jordan, protect re-charge areas and control depletion.
- Revise and unify environmental legislation and indicate agencies responsible for implementation and follow-up.
- Define the mechanism of implementing laws in a way that guarantees prompt decision-making, implementation and, when required, punishment.
- Pass legislation to require local agencies to implement specifications in water projects in accordance with local conditions.
- Pass legislation authorizing municipalities to require citizens to build ground reservoirs to collect rain-water.

6.8 Awareness and Public Participation

Carry out intensive, continuous professionally designed campaigns in all media (radio, television, school curricula) in order to highlight the scarcity of water, its pollution, and means of minimizing consumption and conserving water resources.

Adopt the principle of public participation in deciding the following:

- Selecting sewerage treatment plant sites.
- Selecting waste disposal sites.
- Other major water initiatives (i.e. national changes in water allocation).

6.9 Rationalize Consumption

- Continue to raise the efficiency of maintaining water, sewerage systems and irrigation networks, and seek the necessary funding for this.
- Draw up a plan to minimize the loss in water and irrigation networks through leakage, and seek funding for this.
- Impose a tariff that contains incentives to control consumption of water for potable uses, irrigation and industry.
- Encourage using adequate means to minimize water consumption.
- Local councils should oblige citizens under their jurisdiction to build collecting ground reservoirs.
- Encourage citizens via public-information campaigns to build ground reservoirs to collect rain-water.
- Create incentives for industries that consume small quantities of water or that recycle water, and those which cause no water pollution.
- Reuse water in all fields.

6.10 International Relations

Follow up Jordan's legitimate rights vis-à-vis international waters through:

- Agreements defining management and protection of common water with neighbouring countries.
- Regional and international co-operation in all technical fields related to water and pollution.
- Procure technical and capital assistance from the donor community.

7 INFORMATION SOURCES FOR WATER RESOURCES

7.1 Noteworthy Research and Technical Documents

The following documents do not cover all published and unpublished reports which are available on Jordan's water resources. However, the most important references are included, and many of them are available at the Water Authority of Jordan:

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ANNEX 1 - TABLES FOR WATER**Table 1 - Water Resources in 1989**

Renewable groundwater	280 Mm ³ /yr
Non-renewable groundwater	118 Mm ³ /yr (for 100 yrs)
Surface water	755 Mm ³ /yr
Treated water	32 Mm ³ /yr
Total	1185 Mm³/yr

Table 2 - Distribution of Water Consumption in 1989

<i>Source</i>	<i>Irrigation Mm³</i>	<i>Domestic & Industrial (Mm³)</i>	<i>Total (Mm³)</i>
Renewable groundwater	220	155	375
Non-renewable groundwater	45	11	56
Surface water	500	30	530
Total	765	196	961

Table 3 - Water Sources in Jordan (Mm³)

<i>Source</i>	<i>1985</i>		<i>1989</i>		<i>1995</i>		<i>2005</i>	
	<i>*Avail.</i>	<i>Cons'd.</i>	<i>Avail.</i>	<i>Cons'd.</i>	<i>Avail.</i>	<i>Estim. Cons'd.</i>	<i>Avail.</i>	<i>Estim. Cons'd.</i>
Renewable groundwater	280	313	280	375**	280	359	280	390
Non-renewable groundwater	118	25	118	56	118	118	118	118
Surface water***	466	466	500	500	594	594	755	755
Treated water	20	20	32	32	60	60	60	60
Total	884	824	930	963	1052	1131	1213	1323

* "Available" groundwater means safe extraction. Available surface water, means what has been developed and can be used.

** NB. 25% of amount consumed is from over-pumping.

*** Surface water includes water from spring discharge, surface flow and floods, in addition to treated water from sewerage treatment plants.

Table 4 - Water Uses in Jordan (Mm³)

<i>Use or Purpose</i>	<i>1985</i>	<i>1989</i>	<i>1995</i>	<i>2005</i>
Domestic & Industry	200	242	254	301
Agriculture	624	721	877	1067
Total	824	963	113	1368

Table 5 - Groundwater in All Basins of the Kingdom in 1989
(in million cubic metres per year)

<i>Basin</i>	<i>Quantity Available</i>	<i>Consumed Quantity</i>	<i>Problems</i>	<i>Required Action</i>
Yarmouk	40.0	59.0	Depletion	Safe extraction
Side valleys of Jordan R.	15.0	6.3	-	Increase pumping
Jordan Valley plain	21.0	21.7	Salinization	Change irrigation method
Amman, Zarqa	87.5	153.8	Depletion & salinization	Safe extraction
Dead Sea	57.0	68.6	Depletion & salinization	Safe extraction
Disi (non- renewable)	100.0	56.0	Mineralization	Water allocation
Wadi Araba North	3.5	1.75	-	Can increase pumping
Wadi Araba South	5.5	4.0	-	Can increase pumping
Jafer	27.0*	23.0	Salinization	Change irrigation method
Azraq	28.0	32.0	Salinization & depletion	Safe extraction
Sarhan	5.0	108.0	-	Needs development
Hammad	8.0	1.8	-	Needs development
Total	397.5	428.0		

* 18 Mm³ are non-renewable

Table 6 - Distribution of Surface Water in Basins			
<i>Basin</i>	<i>Continuous Flow (Mm³/yr)</i>	<i>Flooding (Mm³/yr)</i>	<i>Total (Mm³/yr)</i>
Yarmouk, Adasiya basin	200.0	157.0	357.0
Side valleys of Jordan River	52.8	27.3	80.0
Wadi Araba	-	17.0	17.0
Wadi Ziqlab	8.5	1.0	9.5
Wadi Yabis	7.0	2.0	9.7
Wadi Jarm	10.0	0.2	12.2
Wadi Rajib	4.0	1.7	5.7
Wadi Kufranja	4.5	2.0	6.5
Wadi Shuaib	8.8	2.0	10.8
Wadi Kafrein	6.0	2.0	8.0
Wadi Hesban	4.0	0.4	4.4
Zarqa River Basin	46.0	46.0	92.0
Dead Sea Basin	35.0	12.0	47.0
Zarqa Ma'in (Wadi)	20.0	3.0	23.0
Karak	15.0	3.0	18.0
Mujib	35.0	32.0	65.0
Hasa	32.0	4.0	36.0
South Ghor & Wadi Araba	7.1	3.52	10.62
Fifa	4.2	0.3	4.5
Khneizira	1.3	0.3	1.6
Qairawan	1.6	0.4	2.0
Dahl	-	0.17	0.17
Musa	-	0.07	0.07
Hur	-	0.06	0.06
Abu Burqu	-	0.07	0.07
Siq	-	0.25	0.25
Ruqzya	-	1.9	1.9
Bwairideh	-	1.9	1.9
Nakhileh	-	-	-
Turban	-	-	-
Darbeh	-	-	-
Wadi Yutm	-	1.0	1.0
Southern Desert	-	-	-
Jafer	4.0	10.0	14.0
Sarhan	-	10.0	10.0
Azraq	12.0	15.0	27.0
Hammad	-	13.0	13.0
Total	437.0	318.0	755.0

Table 7 - Water Quality of Various Water Basins and Fields

<i>Basin</i>	<i>Causes of Pollution</i>	<i>Salinization Level (ppm)</i>	<i>Required Action</i>
Yarmouk	Increased iron concentration	450-850	Treat iron
Side valleys of Jordan River	Organic pollution	450-750	Chlorination
Jordan Valley plains	Salinization	600-1300	Washing soil
Amman, Zarqa	Depletion, industrial pollution & organic pollution	450-3500	Safe extraction & stop polluting sources
Dead Sea	Depletion & salinization	450-1250	Safe extraction
Disi	-	250-300	-
Wadi Araba North	Salinization of soil	700-3000	Stop intensive pumping in saline areas
Wadi Araba South	Salinization of soil	700-3000	Stop intensive pumping in saline areas
Jafer	Salinization of soil	300-2800	Wash soil
Azraq	Salinization & depletion	300-2500	Safe extraction
Sarhan	-	800-2500	-
Hammad	-	900-3000	-

ANNEX 2- INFORMATION ON WORKING GROUP

A-2.1 Current Membership and Affiliation of Working Group

Name and Title	Affiliation
Eng. Mutazz Belbeisi (Chairman, Undersecretary)	Water Authority
Dr. Abdel Aziz Weshah (Director, Water Resources Studies)	Water Authority
Eng. Subhi Ramadan (Head of Water and Soil Section)	RSS, Box 925819, Amman
Dr. Murad J. Bino (Director, Environment Research Centre)	RSS, Box 925819, Amman
Eng. Ahmad Arafat (Asst. Head, Health Engineering Section)	Ministry of Health, Box 666147, Amman
Eng. Adnan Zawahreh (DOE, Water Section)	MMRA&E, Tel. 672131
Eng. Ahmad Khatib (DOE, Head, Water Section)	MMRA&E, Tel. 672131
Dr. Elias Salameh (Director, Water Research and Studies Centre)	University of Jordan, Water Research and Studies, Tel. 843555, Ext. 2332
Dr. Omar Rimawi (Asst. Director, Water Research Centre)	University of Jordan, Water Research and Studies Centre
Eng. Mahmoud Hyari (Director, Operation and Maintenance)	Water Authority, Tel. 683100
Dr. Mahmoud M. Awad (Assoc. Professor/Head of Water Section)	Yarmouk University, Geology and Env. Dept., Tel. 271100
Dr. Abdel Fattah L. Abdullah (Assoc. Professor)	University of Jordan, Geography Sec.
Dr. Arafat Tamimi (Consultant, Director Env. Sector)	HCST
Dr. Kamel El Qaisi (Assoc. Prof. Engineering, University of Jordan)	JSCEP, Box 921846, Amman
Dr. Husein Zaki (Asst. Undersec., Health Affairs)	Greater Amman Municipality, Box 132, Amman
Eng. Mohammad Bani Hani (Director, Env. Monitoring Section)	Ministry of Health, Box 182210, Amman
Mr. Mohammad Abu Kaff (Head, Environmental Monitoring Section)	Ministry of Health
Dr. Raja Jad'on (Director, Labs. and Water Control)	Ministry of Water and Irrigation, Box 2412, Amman
Eng. Nazih Bandak (Asst. General Manager)	RSCN, Box 6354, Amman
Mr. Muhammad Abu Ajameyeh	Natural Resources Authority, Ministry of Energy and Mineral Resources

Mr. Munther Kharraz
(Irrigation Specialist)

Ministry of Agriculture

Dr. Samir Hijazin
(Head, Groundwater Section)

Ministry of Water and Irrigation

Eng. Zafer Al Alem
(Assistant, Secretary General)

Ministry of Water and Irrigation

Mr. Hussein Al Khandaq
(Environmental Monitoring Section)

Ministry of Health

Eng. Mohammad Shahbaz
(Environmental Sector)

Higher Council for Science and
Technology

ANNEX 3 - KEY INFORMATION SOURCES

A-3.1 Names and Addresses of Specialists in the Water Sector

Name	Organization
Dr. Elias Salameh	University of Jordan
Dr. Murad J. Bino	Royal Scientific Society
Eng. Subhi Ramadan	Royal Scientific Society
Dr. Raja Jad'on	Water Authority
Dr. Omar Rimawi	University of Jordan
Dr. Saqer Salem	Water Authority
Dr. Fawzi Rayyan	University of Jordan
Dr. Munther Haddadin	Private sector
Eng. Mohammad Dajani	Ministry of Health
Mr. Mohammad Yousef Saydam	Royal Scientific Society
Mr. Omar Abdullah	Private sector
Mr. Boulos Kifayah	Ministry of Planning
Mr. Zafer Al Alem	Jordan Valley Authority
Mr. Sweilem Haddad	Private sector
Mr. Bader Harzallah	Private sector
Dr. Omar Joudeh	Private sector
Dr. Mohammad Bani Hani	Secretary General, MMRA&E
Mr. Mohammad Saleh Kiyilani*	Private sector
Mr. Ahmad Thakhqan	Private sector
Mr. Ahmad Kiyilani	Islamic Network
H.E. In'am Mufti	Noor Al Hussein Foundation

A-3.2 Names of Government and Non-Government Agencies

- Ministry of Water and Irrigation, Water Authority and Jordan Valley Authority
- Ministry of Energy and Mineral Resources, Natural Resources Authority
- Ministry of Health and Social Development
- Ministry of Municipal, Rural Affairs & the Environment
- Ministry of Agriculture
- Greater Amman Municipality
- University of Jordan
- Royal Society for the Conservation of Nature
- Higher Council for Science and Technology
- Yarmouk University
- Jordanian Society for the Control of Environmental Pollution
- Royal Scientific Society

- Meteorological Department
- Royal Geographic Centre
- Centre for Environmental Health Activities, World Health Organization

4 • Wildlife & Habitat⁹

The biogeography of Jordan exhibits pronounced regional differentiation due to climatic variation, geological structure, height above sea level, and the amount and distribution of rainfall. These factors account for the diversity of wildlife in Jordan. However, the number of wildlife species is limited, and they are vulnerable to land use impacts of development due to the small size of the ecological areas and the fact that most Jordanian land is semi-desert.

It is imperative that a national wildlife and habitat strategy be formulated to safeguard Jordan's animal species, conserve critical habitats, and improve environmental conditions in the country's different areas.

Jordan's plant species can contribute directly and indirectly to agricultural production as a source of new planting materials, and their development as medicinal species, herbs for human use, and arid-land crops or grasses which can grow in marginal areas of low rainfall where steppe and Hammada vegetation is found. Jordan's endowment of natural vegetation is inextricably linked to its wildlife, and the loss of either would deny future generations the advantages of such diverse species. For this reason, protecting wildlife and plant species is incumbent on all members of the community, as is support of international efforts to preserve our planet.

1 OVERVIEW

1.1 Top Priorities in the Wildlife and Habitat Sector

Nature reserve system for Jordan. Jordan needs international help to implement its system of nature reserves, which would:

- Develop three new reserves to serve both conservation and compatible development where appropriate (Dana Reserve, Wadi Rum, and Burqu).
- Maintain and foster bio-diversity of native species.
- Preserve ecological systems and habitats.
- Restore degraded habitats, especially Azraq Oasis.
- Protect threatened species and re-introduce vanished species.
- Protect migratory birds.

Institutional strengthening of the RSCN. The RSCN needs assistance to enable it to carry out the following:

- Overall planning and management of the nature reserve system for Jordan.
- Technical training in wildlife and conservation area management.
- Teacher training for environmental education.
- Institutional strengthening.
- Conduct environmental impact assessments of proposed projects on wildlife and habitat.
- Create a technical library to house English and Arabic references on Jordan's wildlife and habitats, and appropriate references from other Middle Eastern countries having similar biogeographical regions.
- Set up and equip a meeting room with full audio-visual equipment to support in-house workshops and external training programmes.
- Create a computerized data base on the RSCN's nature reserve system, covering both biophysical and resource management data as well as on-line links with selected scientific databases.

⁹Information in this chapter was prepared by the Wildlife Committee, under the Chairmanship of H.E. Anis Mouasher, Chairman, Royal Society for the Conservation of Nature (RSCN).

- Create in-house airphoto-interpretation capability for site evaluation, selection, analysis and monitoring of protected areas.

Environmental education in the schools.

- Assist the RSCN's programme for establishing Conservation Education Clubs in Jordanian schools.

1.2 Issues of Secondary Priority

- Wildlife legislation.
- Export marketing of restored species.
- Parameters required to guarantee sustainability of wildlife and habitat.
- Illegal hunting.
- Simplification of ecological systems.
- Legal and illegal trading of wildlife as stated in CITES.
- General trends in wildlife conservation.
- Rates of extinction.
- Wildlife conventions (CITES & RAMSAR).
- Wildlife protection management in Jordan.

1.3 Faunal Resources

Mammals. It is estimated that there are more than 70 species and sub-species of mammals in Jordan comprising 24 genera and 7 orders.

Birds. There are an estimated 350 species of birds, which are predominantly migratory.

Reptiles. Estimated at 73 species.

Amphibia. There are 4 species of amphibia pertaining to 4 groups: *Bufo*idae, *Hyla*idae, *Rana*idae and *Pelobatidae*.

Fish. Freshwater species: 18-20; marine species: approximately 1000.

1.4 Flora

Total number of plant species is estimated to be 2300-2400, 2200 of which are vascular plants. (Eisawi, 1985).

- Endemic species are estimated at 100.
- Rare species, between 200-250.
- Threatened species, between 100-150.
- Extinct species in this century, between 10-20.

2 FAUNA OF JORDAN ---

Jordan is located at the crossroads of several biogeographical regions. The key characteristics of Jordan's fauna reflect their diverse origins: the Oriental, Afrotropical and Palaearctic and the original Palaemic, or Desertic.

The location which Jordan occupies between Asia, Europe and Africa has favoured the extension of some animal species from these regions. Also, the presence of four different biotopes in a restricted area such as Jordan is of great significance, as it provides a wide range of diverse habitats. Protection is greatly needed to maintain the country's rich biodiversity, in the face of development pressures acting upon a fragile arid environment.

Endemism. There are no natural barriers between Jordan and the surrounding countries, which enables animals to move freely from one country to another. Consequently, endemics are shared between two countries or more. For example, *Agama (stellio) stellio picea* is

endemic to the area between Jordan and Syria; while *Micrelaps muelleri* is in the area of Palestine, Lebanon and Jordan.

2.1 Capsule Summary of Relict and Endangered Species

Relict species:

Red squirrel, *Sciurus anomalus syriacus*
 Common otter, *Lutra lutra seistanica*
 Snake, *Coluber ravergerri* or *Coluber nummifer*
 Sand dunes, *Psumophila* species
 Gekko, *Stenodactylus dorae*
 Lizards *Sphenops sepsoides* or *Lacerta laevis*

Endangered mammals:

Leopard *Panthera pardus* @ Tafila, Shobak
 Nubian ibex, *Capra ibex nubiana*
 Arabian gazelle, *Gazella gazella*
 Wolf, *Canis lupus*

Endangered reptiles:

Tortoise, *Testudo graeca terrestris*
 Dabb, *Uromastyx aegypticus microlepis*

Endangered birds:

Houbara bustard, *Chlamydotis undulata*
 Pintailed sandgrouse, *Petrocles alchata*
 Chukar partridge, *Alectrois chukar*
 Griffon vulture, *Gyps vulvus*

Vanished, but re-introduced:

Ostrich, *Struthio camelus syriacus*
 Onager, *Equus hemionus*
 Arabian oryx, *Oryx leucoryx*
 Roe deer, *Capreolus capreolus*

2.2 Animals and the Historical Record

Throughout history, Jordan has been known for its forests and plants and was described by many historians and travellers as green and rich in wildlife. Old mosaics and stone inscriptions in Jawa and Wadi Qatif show pictures of oryx, *capra ibex* and oxen. They also show primitive ways of hunting in antiquity. The mosaics in Madaba show the richness of wildlife during the Byzantine era: pictures represent various species like the wild pig, the leopard, Asian lions and birds. The Umayyad desert castles depict the richness of wildlife in the Umayyad period. The visitor to Amra castle can see fresco paintings which show dramatic hunting scenes depicting *Equus hemionus*. There are also paintings of deer, wild rabbits and other species. In the Halabat castle one can see the mosaics which show *Acinonyx jubatus*, wolves, wild rabbits and deer. All these are proof of the rich wildlife in those times.

2.3 Decline in Wildlife

Many of the species appearing in the historical record are now extinct or threatened. The main factor that led to the extinction of wildlife is the deterioration of the vegetation cover in many areas of Jordan due to urbanization. The most destructive period so far witnessed was during the First World War: a railroad was built between Gneiza and Hisha Bida in Shobak, and trees were cut for train fuel. Other factors that led to the deterioration were over-grazing, decrease of rainfall and drying of grazing lands. During the Second World

War, repeating rifles and vehicles were introduced to the area, depleting some wildlife animals to the point of extinction.

In some cases, species left their natural environments and moved to others which were unsuitable. Some of these new areas to which animals fled had weak environmental and biological capacity that could not absorb large additional numbers of the same species. This happened in the case of deer, which fled from the eastern desert to areas with very difficult accessibility. The deer were thus protected from man, but the areas could not provide habitat for large numbers of them. And the intensive chemical pest-control of locusts and agricultural diseases by insecticides has led to increased pressure on wildlife.

2.4 Birds

The RSCN has produced an excellent detailed book on *The Birds of Jordan* (1990), so details will not be repeated in this report. Comments will be limited to bird migration and the habitats which support their stopovers. Most birds in Jordan are migratory. There are two paths of bird migration during the autumn and the spring journeys. The first is through Azraq's perennial oasis, whose safe shelter in the desert is of vital importance to migratory birds from the USSR and east Europe. Annually, some 280 species of birds utilize Azraq. Recent pumping of Azraq water to other parts of the country for potable purposes has lowered the water level and increased its salinity which, in turn, has led to a decrease in the numbers of birds crossing Azraq.

A second path of migration, which is taken by birds coming from west Europe across Jordan, follows the Jordan Valley-Dead Sea-Wadi Araba fault and then extends into the Gulf of Aqaba. Wadi Araba's high mountains channel heat currents up the escarpment, helping big birds in their flying. Some big birds also use high mountaintops to build their nests. Hunting of valuable falcons has increased recently in some desert areas, like Jafer. This has led to a substantial decrease in the number of falcons. Over-use of fertilizers and pesticides in the Jordan Valley may also have a negative effect on birds crossing the area. On the other hand, it was found recently that building dams and other water bodies attract birds. King Talal Dam, the Wadi Araba Dam and Khirbet Samra have become points of attraction for migrating birds, which stay longer than would be expected.

2.5 Reptiles

Jordan is rich in reptiles of special colours, and lizards are seen in all areas. The Jordan Valley and Wadi Araba are characterized by species which do not exist elsewhere in Jordan, due to the elevated temperatures there. There are two orders of reptiles in Jordan: (1) *Chelonia* and (2) *Squamata*, which is divided into two sub-orders: (a) lizards and *Chamaeleo chamaeleon* and (b) snakes.

It is estimated that there are five chelonian species: *Testudo graeca*, which lives on land and is restricted to the Mediterranean environment region; *Mauremys caspica rivulata*, which lives in fresh water; and three other marine species.

There are 4 families of snakes, which include 24 species. In addition, there are 5 species of poisonous snakes recorded in Jordan.

Lizards fall into 7 families, including 45 species and sub-species.

2.6 Amphibia and Fish

Amphibia live and reproduce in or around water bodies. The increasing number of farms in Wadi Araba and the eastern desert has led to the spreading of *Bufo viridis*, a species that was found in the eastern deserts hiding in rat holes in areas like Qasr Halabat, Muwaqar, Um Rsas and Qatrana.

There are four species of amphibia belonging to four families: *Bufonidae*, *Hylidae*, *Ronidae* and *Pelobatidae*. *Pelobates syriacus* is a species threatened as a result of the deterioration of its habitat.

Freshwater fauna. Fishes are mainly in the Jordan Valley and Jordan River, other streams, and Azraq. Freshwater fauna are highly exposed to pollution, increasing salinity and chemical residues as a result of using fertilizers. There are 18-20 species of freshwater fish and 1000 marine fish species (Aqaba Gulf).

3 FLORA OF JORDAN

3.1 Capsule Summary

Vascular plants:

The number of vascular plant species in Jordan is estimated at 2,300 (Eisawi). There are plant groups available in herbariums at the University of Jordan (40,000 samples), Yarmouk University (10,000 samples), and the Ministry of Agriculture (6,000 samples). The maps and studies prepared by Long, Calmbert, Kasapligil, and Eisawi describe plant distribution in Jordan, in addition to available species, both rare and threatened.

Endemics:

- *Crocus monbiticus* – Iridaceae (@ Karak, Mu'ta).
- *Colchicum tunicatum* – Liliaceae (@ Karak, Madaba, Shobak).
- *Iris petrana* – Iridaceae (@ Wadi Musa, Petra, Badia).
- *Verbascum transjordanicum* – Scrophulariaceae (@ Tafila, Petra, Wadi Musa, Ajloun, Jerash, Irbid).

Rare species:

- *Orchis collina* – Orchidaceae (@ Ajloun, Jerash).
- *Romulea bulbocodium* – Iridaceae (@ Karak, Madaba).
- *Biarum eximum* – Araceae (@ Jerash, Ajloun, Mafrq).
- *Globularia arabica* – Globulariaceae (@ Jerash, Ajloun, Salt, Karak, Madaba).

Plants experiencing cutting pressure:

- *Cupressus sempervirens* – Cupressaceae, Wild cupressus, Funeral cypress - (@ Ajloun, Jerash, Allan, Amman, Dibbin, Tafila, Wadi Musa, Petra).
- *Pistacia atlantica* – Anacardiaceae (@ Tafila, Lahda, Shobak, Badia).

Collecting pressure:

- *Tulipa agensis* – Liliaceae, Eyed Tulip (@ Ramtha, Ajloun).
- *Narcissus tazetta* – Amaryllidaceae, spring flowering Narcissi (@ Tayba, Irbid or cultivated).
- *Lupinus varius* – Fabaceae (Lupin) (@ Kufuryuba, Soam, Kufr Asad, Tayba, Kufranja, Deir Alla, Salt, Wadi Shuaib).
- *Cyclamen persicum* – Primulaceae (@ northern Jordan in the forest).

3.2 Types of Vegetation

The vegetation of Jordan can be divided into 13 types (Eisawi, 1985):

- | | |
|---------------------------------------|--|
| • Pine forest | • Saline (halophytic) vegetation |
| • Evergreen oak forest | • Tropical vegetation |
| • Deciduous oak forest | • Sand dune vegetation |
| • Juniperus forest | • Acacia and rocky sudanian vegetation |
| • Mediterranean non-forest vegetation | • Water (hydrophytic) vegetation |
| • Steppe vegetation | • Mud-flats (Qa or Bajada) |
| • Hammada vegetation | |

Description of the most significant types:

- a) Pine forest: *Pinus halepensis*, or Aleppo Pine is the dominant species in the pine forest, and occurs in high altitudes (<700 m). This typical Mediterranean vegetation forms the best forests in Jordan. It is distributed in the Ajloun, Jerash, Dibbin and Zai areas.
- b) Oak forest: this may develop at lower altitudes as a replacement for pine forest where the primary vegetation is degraded. It is a mixed forest comprised of the evergreen oak (*Quercus calliprinos*) and the deciduous oak (*Quercus ithaburensis*).
- c) Steppe vegetation: this type varies with soil and climate and is dominated in the northern region by *Ziziphus lotus* and *Ferula communis*. The presence of shrubs and bushes and absence of trees is a common feature of this steppe vegetation.
- d) Hammada vegetation: this comprises more than 50% of Jordan's total area. There are many species of *Retma ractum*, *Artemisia herba-alba*, *Tamarix* spp., *Astragalus* spp. and *Anabasis* spp. Oases, desert regions and sand dunes support many halophytes (*Saneda* spp., *Juncus littoralis*, *Lycium* spp., *Frankenia* spp., *Arthrocnemum* spp., *Limonium* spp., *Haloxylon*, *Panicum plantago* and *Silene* spp.).

4 PROTECTED AREAS

4.1 Historic Practices

Grazing reserves. Historically, groups of settlers or tribes would protect water springs and grazing lands and trees around their areas, allowing only the tribe to graze its cattle and take their potable water from the area. This would cause conflict between tribes when any of them trespassed on the reserves of the other. In the early times of Islam, Caliph Omar Ibn Khattab declared Huma Durriya (near Madina) a public reserve where camels and horses of the Moslem army could graze. This reserve was approximately nine km long. Caliph Othman Ibn Affan expanded it during his rule. In the Umayyad era, reserves were called *hiran*, referring to low areas where water is collected. The *hiran* had two purposes:

- Guarantee the protection of animal resources by providing sufficient grazing.
- Control hunting and protect wildlife animals against hunters' predations and carelessness.

The modern definition of a reserve is a large area of land allocated legally by the state to protect natural resources within its boundaries. It includes the form and surface structure of the land, biological resources, and historical, archaeological, cultural and recreational resources.

4.2 Current Grazing Reserves (Tables 1 and 2, Annex 1)

The first reserves were established in Jordan as far back as the forties and were designed to study the plant sequence and afford protection to plant cover. Later, attention was given to developing nature reserves for the purpose of studying plant species, collecting seeds and evaluating grazing capability and soil preservation. The Ministry of Agriculture has established 18 grazing reserves with a total area of almost 100,000 dunums; these reserves are listed in Annex 6 – Grazing Reserves in Jordan. It is clear that a key requirement for effective grazing management is the provision of fencing, as illustrated by the following reserves:

Khanasiri Grazing Reserve (Mafraq): established in 1946, with an area of 4545 dunums and annual rainfall rate of 220 mm. The reserve is fenced; plant production in the area protected from grazing in the spring of 1990 was estimated at 80 kg/dunum of dry matter, whereas it was only 7 kg/dunum in the section opened for grazing.

Surra Grazing Reserve (Ma'raq): established in 1946, area 4,000 dunums, annual rainfall rate 180 mm. The reserve is fenced; grazing in it is permitted in selected seasons for three months a year only. Plant cover is good.

Fujeij Grazing Reserve (Ma'an): established in 1958, area 10,000 dunums, annual rainfall rate 200 mm. The reserve was grazed by a herd of sheep under the authority of the Ministry of Agriculture until 1985; then it was rented to the Jordanian Company for Animal Production until 1989, when it was returned to the Ministry of Agriculture. It will be restored soon.

Azraq Desert Grazing Reserve (Azraq): established jointly by the RSCN and the Ministry of Agriculture, Department of Forests, to provide a grazing area for the Arabian oryx, which lives in the Shaumari reserve and which is increasing in number. The Azraq reserve is located alongside the Shaumari reserve; its area is 300 square km, and it is about 500-700 m above sea level. It includes a network of valleys which are covered by thick plant cover.

The Ministry of Agriculture fenced the reserve, and is now working to increase the grazing cover, while the RSCN will work on breeding species and introducing the oryx, deer, ostrich and onager. *Artemisia*, *Achillea*, *Artriplex* and *Poa* grow in this reserve. To date 134 species of birds have been recorded there; most of these are migratory. Animals now found in the reserve are the deer, striped hyena, wolf, fox and wild rabbit, in addition to two or three species of snakes.

4.3 Existing Wildlife Reserves (Tables 3 and 4, Annex 1)

1) Shaumari Wildlife Reserve: Jordan's first wildlife reserve, established by the RSCN in Wadi Shaumari in 1975, with an area of 22 square km, is surrounded by a fortified fence. Almost 60% of the total area consists of shallow valleys; the remaining areas are plains covered by basalt stones (Hammad). The reserve ranges between 510-680 m above sea level. A herd of Arabian oryx was re-introduced in its native Jordan in Shaumari after contacts with the WWF. In 1979, the RSCN received four pairs of Arabian oryx from the Santiago Zoo. These animals bred successfully inside the breeding units. In 1983, 31 head of these were released inside the reserve and continued breeding in nature. Some of them were given to Arab countries. At present, there are over 100 head of oryx on the reserve. The goitered gazelle, ostrich, and onager are being bred currently. Eleven species of mammals and 134 species of birds, mostly migratory types, were recorded in the reserve, in addition to 130 wildlife species, most important of which are *Artriplex*, *Artemisia*, *Tamarix*, and *Retama*.

The RSCN is working to establish a school for teaching wildlife management that would accept students from Jordan and neighbouring Arab countries. In fact, the RSCN is seeking to make Jordan a model for the neighbouring Arab countries in this field.

2) Azraq Wetland Reserve: called such in reference to the Azraq Wetland Oasis located in the east of Jordan, the reserve is part of this oasis and amounts to 12 square km covered by ponds, swamps and aquatic plants. It provides a habitat for migratory birds from Africa to Asia. The Azraq Wetland Reserve was considered by the Ramsar convention a wetland of international importance for migratory birds; three hundred and seven species were recorded in it. It is also rich in animal and plant wildlife and is semi-covered by aquatic plants such as *Typha* and *Tamarix*. The wolf, red fox and striped hyena are among the important animals found there. The reserve is now threatened due to the shortage of its water, which has been over-pumped for agricultural and urban purposes, especially to supply Amman and the northern areas with potable water. The RSCN is making intensive efforts to rationalize pumping in order to protect the reserve against dryness and salinization.

3) Zobia Wildlife Reserve: this reserve is located within the Irbid governorate in the Ajloun mountains, and its area is almost 10 square km. Almost 900 m above sea level, the reserve is covered by thick forests of oak, *Pistacia*, *Arbutus*, juniper, carob, *Crataegus*, wild pear, and *Rhamnus*. The RSCN is re-introducing and breeding rare types of roe deer which vanished from Jordan a hundred years ago, and the Persian fallow deer, which is characterized by its

global rarity (there are 150 of them in Iran). Other wildlife animals such as the wild pig, striped hyena and red fox, in addition to various species of wildlife birds and plants like *Iris nigricans* and iris will also be introduced. A fence for the reserve was funded in co-operation with WWF and USAID.

4) Mujib Wildlife Reserve: the objective of establishing this reserve was to protect wildlife animal and plant groups within its boundaries, re-introduce extinct species like the *Panthera pardus*, and highlight the beauty of the area and organize tourism in it. Mujib Reserve, which is next to Wadi Mujib, is located on the eastern coast of the Dead Sea. It is so steep towards the Dead Sea that its altitude ranges between 400 m below sea level and 800 m above sea level. The reserve includes 212 square km and has mineral springs and some rare plants such as *Himantoglossum affine*, *Tamarix*, *Acacia*, *Oleander*, and *Phenix*. Many wildlife animals like the Nubian ibex, mountain gazelle, wolf, rock hyrax, and striped hyena live in the reserve, in addition to wildlife birds like the partridge.

5) Dana Wildlife Reserve: this beautiful reserve is located close to the village of Dana near Tafila and has an area of almost 120 square km. Juniper, *Pistacia*, cyprus, oak, and pine grow here, as do wildlife animals like the Nubian ibex, mountain gazelle, wolf, fox, jackal, badger, hyrax, porcupine, hare, striped hyena, Indian crested porcupine and the wild rabbit. The *Panthera pardus* is still living in this area. The RSCN is currently studying how to develop this area touristically and to protect nature, in addition to assisting social development in the residential areas surrounding the reserve.

6) Wadi Rum Wildlife Reserve: includes the Rum mountains in the south of the Kingdom. It comprises almost 560 square km, and its altitude ranges from 800-1750 m above sea level. The reserve is internationally famous for its beautiful scenery and desert plants. This reserve was established to protect rare wildlife animal and plant groups living in it and to re-introduce the Arabian oryx and gazelle. Its wild animals include the Nubian ibex, mountain gazelle, striped hyena, wild rabbit, hedgehog, porcupine, and the Indian crested porcupine, in addition to some species of birds like the golden eagle, the Egyptian eagle and the Sinai pink eagle.

4.4 Future Wildlife Reserves

1) Burqu Wildlife Reserve: located in the Jordanian *Badia* in the northeastern area of the Kingdom and named after the Roman/Byzantine castle at Burqu, which is located within this reserve. It covers 950 square km and is 650-750 m above sea level. Wild plants like *artimisia* grow in here, in addition to certain species of reptiles, rodents and desert birds. It is said that some species of wild animals like the gazelle, striped hyena, red fox, wolf and *Caracala caracala* also live in this reserve. The objective of establishing this reserve—in addition to wildlife protection—is to re-introduce some extinct animals there such as the Arabian gazelle, dorcas gazelle, onager and ostrich.

2) Rajil Wildlife Reserve: located in the northeastern Jordan *Badia*, it was named after Wadi Rajil, which runs through it. Its area is 860 square km, and it is 580-600 m above sea level. The objective of its establishment, in addition to preserving the wildlife animals and plant species living in it, is to re-introduce the onager, the *Caracala caracala* and some species of gazelles which had vanished from Jordan. The hyena, gazelle, wolf, red fox, wild rabbit, gerbil, and leopard have been observed there.

3) Abu Rukba Wildlife Reserve: located in the south of the Kingdom, it is named after the Abu Rukba Mountain, which forms part of it. Its area is 410 square km and it is 700-1100 m above sea level. The objective of its establishment is to re-introduce the mountain gazelle and reem gazelle to their native habitat. Desert plants, wildlife animals and birds, like the bustard and others, live there now.

4) Jerba Wildlife Reserve: located in Jordan's south, it is named after Wadi Jerba, which runs through it. Its area covers 40 square km, and the local relief ranges from 1280-1600 m above sea level. The objective of its establishment is to develop plant cover and wildlife resources, and to re-introduce the mountain gazelle.

5) *Jabal Mas'ada Wildlife Reserve*: located in the Kingdom's south, it is named after Jabal Mas'ada which is 1150 m high and located within the reserve. Its altitude ranges between 180-1100 m above sea level, and it covers 510 square km. The objective of its establishment is to conserve animals, plants, and birds living there, which include the Nubian ibex, mountain gazelle, striped hyena, fox, wild rabbit, and wolf badger.

4.5 The Special Case of Azraq

Azraq Desert National Park. Official interest in establishing national parks started in 1965 in Jordan when HM King Hussein asked the government to prepare a national programme to protect nature and to establish national parks. The government allocated 5,250 square km of the Jordan *Badia* lands as the first national park in Jordan; it was called Azraq Desert National Park. However, the establishment of this park was impeded because of the difficult conditions which the country passed through as a result of the Israeli occupation of the West Bank in 1967. Other obstacles and problems facing the establishment of this park were:

- The existence of two big villages in the area: Azraq North Village, and Azraq South Village, with a combined population of 5,000 inhabitants.
- Construction of a highway to connect Azraq with Iraq and Saudi Arabia; this divided the park into three areas.
- Pumping water from Azraq Oasis to the Amman area and the northern areas of the country.
- Local residents working in salt mining in the area.
- Local residents' practice of over-grazing.
- Hunting permitted in the area.
- Military bases located inside the park.

The above obstacles made it hard to establish the park, prompting the RSCN to adopt a new strategy which called for establishing nature reserves on smaller fenced pieces of land to more effectively protect and breed wildlife animals and re-vegetate over-grazed land. To reduce conflict, lands to be used for reserves were selected in areas far from human activity. Two or more reserves can be joined later to form a national park whose area would conform to international standards for nature reserves and national parks. (See Annex 6-Definitions and Criteria of Areas Used in Wildland Management).

*Designation of Azraq Oasis as a Ramsar Site*¹⁰: Azraq Oasis was designated a Ramsar site in 1977. It still represents a wetland of great ecological, economic and social value, meeting several of the criteria established under the Convention for identifying wetlands of international importance.

Unfortunately, a recent evaluation reveals that its ecological character has deteriorated over the past decade, largely as a result of groundwater extraction.¹¹ It is abundantly clear that unlimited exploitation of Azraq Basin water will ultimately destroy this resource through salinization. Only the timing of such an occurrence is in any doubt. Hence, over-exploitation will lead not only to the disappearance of an ecologically outstanding area, but also to the loss of the considerable benefits which the wetland provides to the people of Jordan. Every effort should be made to ensure that no further deterioration occurs.

¹⁰Jordan is a signatory to "Ramsar", the Convention on Wetlands of International Importance Especially as Waterfowl Habitat.

¹¹Jones, T.A. and J.E. Clarke. (1990). "Azraq Oasis, Jordan". Ramsar Convention Monitoring Procedure (Report No. 16). IUCN/IWRD, Gland, Switzerland.

How Much Water Extraction is "Safe"?

The concept of "safe yield" is clearly fundamental to the future of Azraq. Whilst 20 MCM has been identified as the maximum sustainable *total* yield (government and private/unlicensed extraction), it should be remembered that this level of exploitation would, at best, only maintain the wetland in its present severely impoverished condition. The former ecological character of the oasis could not be fully restored without a substantial reduction of total extraction below the maximum "safe yield."

The Jordanian government recognizes these points and has established levels of groundwater extraction which should not be exceeded if Azraq's water is to be exploited sustainably, given the provisos mentioned above. If implemented effectively, such "wise use" (Article 3.1 of the Convention) could allow Jordan to benefit indefinitely from an irreplaceable water resource, and at the same time, to fulfil her international obligations under the Ramsar Convention.

4.6 Current Trends

Official interest in wildlife management and protection is indispensable for achieving goals in this field. The fact that environmental protection was neglected over a long period of time led to the deterioration of nature in Jordan and the extinction of many wildlife animals and plants. This study aims at providing a basis for re-introducing these animals and plants and restoring the balance of the components of the natural environment. This can be achieved, in part, through establishing nature reserves managed by staff with proper scientific and practical qualifications.

Decline in land quality. Current trends show that the natural plant cover is deteriorating, land production yields are below capacity, and less nutritional and less favourable plant communities are replacing the original ones. Desertification in the *Badia* area has reached an advanced stage. Major problems are appearing in the soil—increased salinization and recession of plant cover—as well as high rates of evaporation of rain-water in the area.

The steppe suffers from destruction of plant cover, and winds and rain erode its soil and lead to desertification. The continuation of land fragmentation and plant-cover destruction are a major cause of the decrease in the number of animals depending on natural grazing.

In mountainous areas, natural forests are decreasing due to extensive cutting of trees either to be replaced by fruit trees or to be used as wood. In addition, the plant cover is destroyed by over-grazing and fires.

The Ghor areas are becoming polluted due to improper disposal of waste water and intensive use of chemical insecticides, in addition to increased salinization in many areas.

We can see from the above that the plant cover in Jordan is badly managed, and that turning grazing lands over to private agricultural uses (effected when village boundaries were drawn in 1930), and expanding non-irrigated farming to the east and south, have caused a disturbance of the ecological system in extensive areas.

4.7 Future Trends

Indications regarding future trends show the following:

- Harvesting of great quantities of groundwater will lead to its depletion and salinization.
- More grazing and nature reserves are expected to be established.
- Soil dams planned in the *Badia* and steppe areas will improve the plant cover there.
- Agricultural areas are expected to shrink due to continued urban expansion in mountainous areas.
- The steppe areas will be the focus of greater attention, to protect plant cover and soil erosion.

The Ministry of Agriculture Law which organizes the process of protecting natural plant cover, grazing, and forests is not duly implemented; some of its articles require amendments to control the deterioration of plant cover. In spite of financial and technical obstacles, the Ministry of Agriculture has so far established 18 grazing reserves for the purpose of protecting natural plants and developing grazing lands. However, the total area of these reserves does not exceed 0.5% of Jordan's total area. The Ministry of Agriculture will continue to establish grazing reserves within its annual plans. The total area registered as forests includes around 1 million dunums (less than 1% of Jordan's total area); 250,000 dunums are natural forests and 300,000 were afforested in recent years. The Ministry of Agriculture tries to afforest 30,000 dunums annually.

4.8 Agencies Responsible for Nature Protection

Wildlife protection enjoys special attention from the government and various agencies, three of which are entrusted with the task of protecting the Kingdom's wildlife.

Ministry of Agriculture. A specialized staff within the Ministry oversees protecting, monitoring and establishing new forests; other personnel are responsible for establishing grazing reserves and improving natural forests. The first grazing reserve was established in 1946, and there are now 18 of them in Jordan. The Ministry of Agriculture has responsibility for the following issues:

Agricultural reserves: these should be located near water sources like dams, rivers and valleys because the soil is washed and carried to these areas, causing increased growth of algae and other living organisms.

Eradicating pests: sometimes done in an unplanned manner so that both harmful and beneficial pests are killed. This throws the ecological systems off balance and can lead to their deterioration. In addition, the possibility of developing species immune to pesticides and destroying beneficial bacteria which contribute to soil fertility is quite possible.

Insecticides: residuals of insecticides in the soil, their contribution to developing immune species and their harmful effect on water and soil make their use potentially hazardous. Their use must be governed by environmental legislation, which is being formulated.

Protection of trees and plants: the public must be informed about the following issues: the importance of plant cover for protecting soil against erosion and the harmful effects of human activities on plant cover; the important role trees play as accommodation for many species, especially birds, in addition to their role in maintaining the ratio of CO₂ and O₂ in the atmosphere, thus moderating the local climate.

Forest resources and soil preservation: forests are a community resource and should be protected by regulations and laws and through campaigns to raise the level of public awareness. Proper disposal of dry material is essential to prevent fires. Grazing in forest areas may threaten the numbers of living organisms which depend on forests as a major source of their food.

Management and protection of grazing lands: protection and conservation are a national duty that requires co-operation from many parties, including individual citizens. Good management of grazing lands requires the timely organization of ploughing and fires as well as other management tools to prevent the natural disasters which result in the loss of the species that inhabit these areas.

Export and import of animals: among the greatest threats to wildlife in a given area is the import of disease to the wild herd by introduced animals. Introduction of animals should be controlled by law, with severe penalties for offenders.

Protecting wildlife birds and animals and organizing hunting: one of the main factors leading to the extinction of wildlife species is the loss of habitat and the necessary biological environments. Unorganized hunting has the same harmful impacts; laws are needed to ensure that wildlife species can live safely with human beings.

Growing of bees and silkworms: insects of economic value are an important element in industrial and agricultural systems, and they must be protected against insecticides and pesticides.

Biological health and disease eradication: healthy wildlife and domestic animals are less likely to fall prey to disease than those in a weakened physical state. Therefore, the Ministry of Agriculture must continuously monitor animals and plants so that harmful organisms which could lead to the disturbance of agricultural systems can be controlled.

Veterinary quarantine: veterinary quarantine is a means of controlling local diseases and those coming from abroad; many epidemics are caused by incoming diseases and organisms which have no natural enemies locally.

Preserving fish and marine life resources and regulating hunting: preventing urban wastes from reaching water resources is vital for fish living in fresh water, and controlling coastal pollution is vital to developing fish populations in sea water. Regulating factors leading to water pollution and controlling fishing are particularly important in countries like Jordan with limited animal protein resources.

Royal Society for the Conservation of Nature (RSCN). This organization is a private voluntary society involved in nature reserves, currently supervising seven such reserves. Some of these, such as Shaumari Wildlife Reserve and Mujib Reserve, were established more than ten years ago. Other reserves are being set up. Through its technical staff and experts from Jordanian universities, the RSCN has played a distinguished role in wildlife protection, especially in restoring the Arabian oryx and wild gazelle populations.

Department of Environment. The Department is attached to the Ministry of Municipal, Rural Affairs & the Environment and was established in 1980. Responsibilities are to monitor various Jordanian environmental laws, including those related to wildlife, pollution, and misuse of national resources. The department also defines elements and objectives of environmental issues to guarantee co-ordination with urban development, and prepares detailed plans and policies to protect the environment on both short- and long-term bases.

4.9 The Importance of Environmental Protection:

The importance of protecting the environment has far-reaching implications for Jordan's wildlife and plants:

a) Conservation of wildlife species: experiments, observations, and scientific and analytical studies prove that protecting Jordan's various environments, whether fertile lands, those with good rainfall, marginal lands, or even desert areas, is one of the cheapest and most effective means of protecting wildlife animals and plants. Plants living in the local environment, for example, do not need special care, as they are already adjusted to their surroundings.

b) Conservation of rare species: certain endemic species like iris do not grow in Jordan except in natural wildlife reserves. For example, there are seven wildlife species in Dab'a Grazing Reserve which do not grow elsewhere in the country.

c) Conserving the soil and increasing its fertility: there is no doubt that protection in any limited area brings about an increase in the numbers of plants. As a result, the plant cover increases, adding large quantities of organic matter to the soil. At the same time, increased plant cover prevents erosion by wind or rain and prevents dehydration of the soil.

d) Conservation of wildlife animals and re-introduction to their native habitat: protecting plants means that wildlife animals can be re-introduced to areas as food and habitat are provided. It is inevitable that wildlife animals die or diminish in numbers when the plant cover—and the necessary environment—is destroyed. Ground cover protection in Jordan has made it possible to re-introduce the Arabian oryx to the Jordan desert. There are now over a hundred head of this species in the Shaumari Wildlife Reserve.

e) Increasing animal resources: establishing, developing, and maintaining wildlife reserves in Jordan will allow animal population to increase in Jordan. This could significantly raise meat production, provide hard currencies and help to improve national income. One such reserve is the Ministry of Agriculture's Fujeij Reserve in Shobak. Official interest in wildlife and wildlife protection is basically sound and can be improved.

Hunting and other regulations related to wildlife were not strictly enforced before the establishment of the RSCN in 1966. By that time, wildlife had already deteriorated. Plants, especially in grazing areas, are still not properly managed. Great destruction is taking place as a result of unnecessary ploughing, over-grazing, cutting bushes for fuel, and urban expansion. And although responsibility for wildlife protection is assigned to the Dept. of Forests in the Ministry of Agriculture, it has neither the necessary legislation to control all the various aspects of wildlife nor the power to execute legislation. Therefore, the Minister of Agriculture has delegated authority to the RSCN to enforce the Wildlife Animals and Birds Conservation Law.

4.10 Summary of Current and Future Trends in Wildlife Conservation and Protection

Habitat destruction. The goal of hunting in the past was to obtain food for survival. Now, however, hunting has become a hobby and a sport. Hunting is practised to a limited extent in Jordan's vast desert areas and also in mountain and valley areas.

The decline in wildlife resources and threat of extinction are due to various reasons, most important of which are illegal hunting, urban development and expansion, insecticides, use of modern arms and vehicles, plant cover destruction, egg loss, outbreak of epidemics and lack of environmental awareness. Those which have vanished include the Arabian oryx, lion, panther and deer. Others are deteriorating and moving towards extinction, such as the Nubian ibex, *Gazelle subgaitroja*, reem gazelle, goitered gazelle, and birds such as the ostrich, houbara bustard, partridge, francelin, sand grass, and sand partridge.

The Minister of Agriculture delegated the authority to enforce hunting regulations to the RSCN upon its establishment. The RSCN has worked to introduce environmental awareness among hunters and to implement hunting laws and regulations through its members, its inspection and information staff and its periodical *Al-Reem*. The RSCN tries to achieve a natural wildlife balance and to protect wildlife from extinction and deterioration.

Establishing nature reserves. The RSCN will continue establishing nature reserves until all main habitats are represented in the reserve system. Re-introduction of local species will also continue.

Expansion of environmental education. A programme of public awareness and information programmes will be continued, strengthened and intensified. Red Data Books are being prepared on wildlife animals and native, rare, and threatened plant species. Scientific research on wildlife animal and plant reserves, as well as on rare species and their classification, is being carried out in some scientific centres, particularly at the University of Jordan.

4.11 Some Main Initiatives and their Impact on Jordan's Economy

- A clear agricultural policy that defines proper land uses, especially in the eastern area and where natural grazing lands occur.
- Establish nature reserves and other protected areas.
- Continue to establish and expand grazing reserves as done by the Ministry of Agriculture and the Co-operative Corp.
- Afforest lowlands in government and privately owned lands.
- Send a number of employees to specialize in range management, improve plant cover, and provide trained personnel to work as consultants in the field of grazing lands.

- Increase feed production on non-irrigated lands instead of fallow lands, and expand irrigated farming, especially in desert areas.
- Feed wildlife animals when necessary and possible.
- Control the destruction of forests by wildlife animals.
- Take the necessary veterinary procedures to protect health of selected wildlife.

5 REASONS FOR DEPLETION OF WILDLIFE AND HABITAT RESOURCES

5.1 Destructive Practices & Pressures on Wildlife Resources

Vehicles. These destroy plant cover, and there is a deterioration of soil in certain areas due to uncontrolled use of four-wheel-drive vehicles in particular.

Urban expansion. Using agricultural lands or lands supporting natural forests for urban expansion and settlements is an issue that should be addressed immediately in Jordan; land fragmentation is a related problem that puts pressure on wildlife resources. The use of plastic greenhouses on land agriculturally fit for crops and beans should be investigated further; the use of insecticides in greenhouses can kill beneficial bacteria and cause soil to lose its fertility.

Destruction of plant cover. This is caused by goats, which tear tree bark. Goats also prevent regrowth of tissues, since they feed on weeds, not only biting the green material but also the seeds and lower parts such as roots, which prevents the spontaneous regrowth of plants.

Cutting trees. The irreversible negative impacts of plant cover destruction include loss of soil, increased desertification, imbalance of natural ecological systems and loss of diverse environments. The degraded environment which results is incapable of sustaining rural livelihoods. Eventually, as incomes fall, rural inhabitants are compelled to emigrate.

Fires. Fires are considered the most serious problem facing wildlife animals and plants because they destroy large areas of plant cover, leading to soil erosion and to changes in soil that alter its chemical and physical properties, and thus destroy micro-organisms. In addition to the great loss in public and private property, surviving animals would have to migrate because of the destruction of their environment. Deliberate fires are very rare in Jordan, not exceeding 2-5% of the total fires. Fires are usually made to justify expansion of agricultural lands over government lands or because of special purposes such as revenge or hiding crimes. Deliberate fires are often set in the Dashsheh area in Azraq Wetland Reserve to provide grazing for cattle, cows and camels.

Overgrazing. Overgrazing in marginal environmental systems is one of the most important causes of species extinction. Competition between domestic and wild animals is supervised by man for the benefit of domestic animals. Over-grazing results in desertification, soil erosion and increasing environmental load. Eventually, the environment is unable to support living organisms.

Agricultural practices. The various activities of agricultural systems affect not only the systems themselves but also other surrounding natural systems. Using harmful agricultural techniques and alien materials in natural systems can cause negative impacts such as imbalance in the food chain. This leads to an increase or decrease in certain species, causing the collapse of the food hierarchy in the natural system. Laws can help control harmful agricultural practices and decrease, to a certain extent, the danger of disturbance. At any rate, positive agricultural practices are a national duty, and farmers should be encouraged to adopt them. Alternative concepts for an environment-friendly solution to any agricultural problem should be introduced as well.

Mining activities. Extraction of metals leads to serious environmental problems; removal of topsoil and accumulation of toxic wastes lead to the extinction of many species which are not capable of rapid adjustment. Therefore, legislation requiring any public or private firm to reclaim the land and restore plant cover is a very important issue and all legal results should be taken into consideration.

5.2 Economic & Political Impacts

In addition to the benefits of wildlife species in preventing desertification and providing proper climate for man's life and development, these species can be a natural resource that can be used to support the Jordanian economy in different ways:

- Develop plants and herbal beverages as alternatives to coffee and tea.
- Develop new plants for food by breeding and crossbreeding, especially to increase feed production.
- Develop special hunting areas to support local and outside tourism.
- Develop animal resources by using grazing lands in a sustainable manner.
- Protect forests and nature reserves and use them for touristic purposes.

Besides contributing to the national economy, all such activities would provide job opportunities, especially in rural areas, and would help control migration to the cities.

5.3 Obstacles to Sustainable Use of Wildlife Resources

Funds available for the conservation of wildlife are restricted to the amount that the RSCN spends on its projects—mainly nature reserves and protection of hunting resources—and what the Ministry of Agriculture (Dept. of Forests) spends on soil conservation, nature reserve protection and grazing reserve establishment.

Absence of zoning laws in Jordan harms wildlife species by allowing plant cover to be destroyed in grazing lands and in eastern areas by over-grazing, ploughing and uncontrolled movement of vehicles. Haphazard urban expansion also has harmful impacts. Therefore, defining land use should be the most important requirement of the national strategy.

Limited rainfall in grazing lands of the eastern areas used to limit sheep herds. Now, however, tanker trucks bring water for the sheep, prolonging their stays in such areas and leading to destruction of the plant cover. Government management of the *Badia* is restricted to small grazing reserves, while other extended grazing areas are neglected.

Plans designed for the use of grazing lands in an economic and sustainable manner are unable to meet production requirements, which depend on soil, water use and geographical climatic conditions.

Jordanian legislation protecting wildlife species is restricted to laws protecting birds and game animals in forests. Enforcement of these laws is very lax.

Low production of feed in irrigated and non-irrigated agricultural areas increases pressure on natural grazing lands and will inevitably diminish their productivity and growth.

There is a lack of scientific centres specializing in environmental studies and research on aridland wildlife animals and plants. Such centres would have great relevance to protecting the biological diversity in Jordan, which is an important tool for tackling desertification problems and loss of soil.

6 RECOMMENDED ACTIONS FOR WILDLIFE AND HABITAT

6.1 Land and Information

Public and private lands and wildlife: the current environmental situation in Jordan requires greater protection of the largest possible areas of public lands (*amiriyah*), in order to protect the greatest number of wildlife species possible; the availability of different habitats supports different species and encourages diversity. This is a national strategic objective.

Privately owned lands and wildlife: an informed citizenry can contribute to the promotion, understanding and appreciation of wildlife. Ideally, if threatened species live in their lands, they would protect animals voluntarily. Proper encouragement and incentives will help in achieving this aim.

Public relations and information:

- a) Promote co-operation and co-ordination with the Ministry of Education, emphasizing flexibility in dealing with environmental education.
- b) Promote efficiency of the Information Section of the RSCN through:
 - Facilitating attendance of the section's personnel at local and international seminars and workshops.
 - Provide adequate staff and equipment (car, video camera, mobile unit equipped with all materials for exhibition) to enable the section to carry out its work efficiently and to expand in future.
 - Organize field trips for the information section staff to places with special environmental problems or having special characteristics to enable them to answer questions of visitors and students.
- c) Establish an environmental education programme (see Section 7.5).

6.2 Habitat Protection

- a) Protection has led to increased numbers of plants in many areas. The increased plant cover and organic matter in the soil has improved the quality of the soil and prevented erosion and dehydration. It also increases and ensures bio-diversity.
- b) Conservation of wildlife animals and restoration of plant cover will eventually provide the necessary food and habitat for threatened and re-introduced wildlife species. The Shaumari reserve, for example, made it possible to restore the Arabian oryx to the Jordanian desert.
- c) Establishing grazing reserves could increase animal resources and meat production in the Kingdom to the point of self-sufficiency in meat. It would also increase the national income by providing hard currencies. Example: Fujeij Grazing Reserve in Shobak, managed by the Ministry of Agriculture.
- d) Protection alone is not sufficient as a target for the national strategy. Conservation and enhancement is also required. The most important thing is to deal with changing factors in a way that harmonizes with the conservation of all species and increases their diversity to help improve life-supporting ecological systems. This vision will not be achieved except by continued research within the various habitats.

6.3 List of Projects to Decrease Pressure on Wildlife and Habitat Resources

These projects should be directed to resources which are threatened:

- Grazing: establish special farms for sheep and provide them with concentrated feed; establish grazing reserves to prevent plant cover destruction and soil erosion.
- Hunting: ban hunting in Jordan for the coming ten years. If there is still demand for this sport, breed species of fast-reproducing birds in suitable areas.
- Environmental destruction: monitor environmental changes due to water, air and ground pollutants.
- Environmental Surveys of the Jordanian environment: establish a broad base of information using original studies of the Jordanian environment made by local specialists and experts, in order to project future changes.
- Control excessive use of water resources, especially groundwater.
- Provide information.
- Establish nature reserves and select environmentally diverse sites.
- Prevent soil erosion.
- Establish man-made forests and grazing lands.

- Control desertification.
- Ban farming in steppe lands.
- Take population, urban and economic growth into consideration when planning.
- Plant forests on a large scale, especially trees of local origin.
- Introduce relevant laws and empower agencies to enforce them.
- Ban the felling of trees and, the use of branches and bushes for fuel.
- Control use of groundwater, especially non-renewable groundwater; excessive use leads to salinization and depletion of water reserves.
- Prevent harmful agricultural practices: (i) cycle crops; (ii) use breeds especially appropriate for Jordan; (iii) use fertilizers, insecticides and chemicals more sensibly; and (iv) protect agricultural areas from urban and population expansion.
- Mining activities: an EIA should be carried out before embarking on any project (like Hasa, phosphate, or Ajloun forest activities, and other issues).

6.4 Wildlife Management Procedures

Wildlife management involves caring for wildlife animals by promoting their health and productive efficiency, while maintaining correct environmental conditions. Maintaining the optimal natural balance may require one or more of these management procedures:

- Controlling density of wildlife animals in the defined area.
- Organizing the male/female ratios.
- Fixing the target age.
- Promoting hunting productivity.
- Setting an annual hunting plan on a scientific basis.
- Selective hunting.
- Maintaining hunting weapons.
- Enforcing hunting laws.
- Maintaining hunting dogs and their pure distinctive breeds.
- Maintaining national hunting traditions.
- Annual growth.
- Feeding wild animals and improving grazing.
- Maintaining barns, mangers and feeding.
- Establishing nature reserves, national parks and grazing reserves.
- Mitigating the harm caused by wildlife to forests and farms.
- Veterinary prevention.
- International trading of animal and plant species.
- Caring for management of wildlife animals on the international level.

6.5 Agricultural Lands

Agricultural lands in Jordan do not exceed 6% of its total area, and are dependent upon rainfall rate and availability of irrigation. Agricultural lands are continually being lost due to urban expansion, soil erosion and pollution from overuse of insecticides. Areas lost during the second half of this century are estimated at 25% of the total agricultural lands.

Recommendations:

- Protect agricultural land against conversion to other incompatible uses; direct construction and settlements to rocky areas or areas which do not meet agricultural requirements.
- Treat causes of soil erosion.
- Use chemical insecticides more sensibly.

6.6 Grazing reserves

These have been established and managed by the Ministry of Agriculture, Dept of Forests. There are 17 such reserves, aimed at developing grazing resources and controlling grazing inside them so that the plant cover does not deteriorate.

Recommendation:

All grazing lands in Jordan should become grazing reserves and be opened to grazing according to the land's capacity in the various grazing seasons. This requires defining grazing lands and the parties responsible for protecting and using them.

6.7 Forest areas

These include natural forests, or areas afforested before or since 1927. Despite efforts made by the Ministry of Agriculture to afforest and protect lands, this activity has been restricted to the Ministry of Agriculture and carried out on government lands only.

Recommendations

- Provide more protection for forests, especially against over-grazing, cutting and fires.
- Provide for natural breeding of plants.
- Expand afforestation to include privately owned lands unfit for fruit tree cultivation. Issue necessary laws to protect owners, including incentives to encourage and help them to afforest their lands.
- Decrease the danger of fires by encouraging planting of flat-leaf trees like oak, or at least plant fire lines of these trees. Actions should also be taken to decrease the danger of fires set to burn weeds growing on side paths.
- Expand afforestation by making a green belt along the east side of the national railroad network to prevent desertification.

6.8 Developing the Zarqa River Basin Project

The Zarka River Basin Project aims at protecting the soil from erosion by building reinforcement walls and planting fruit trees. The Ministry of Agriculture is implementing it, in co-operation with international agencies.

Recommendation: Involve environmental habitat specialists in studying the environmental impact of such a project to conserve the supporting ecological systems of this distinct habitat.

6.9 The Hammad Project in the Eastern Areas

This project aims at protecting the elements of nature, especially grazing plant cover and water resources. The project is being implemented by the Ministry of Agriculture in co-operation with specialized Arab agencies.

Recommendation: It is recommended that the project's activities cover all areas of the Jordanian *Badia*, and that more than one pioneer site be selected.

Grazing lands. Most Jordanian lands which fall under the rainfall rate of 200 mm are considered natural grazing lands, most important of which are the marginal areas with rainfall rate ranging between 100-200 mm, and the areas between the Jordan Ghor and the eastern agricultural lands (called Hamra).

The most important reasons for the deterioration of grazing lands are over-grazing and ploughing in marginal areas, cutting of trees and movement of civilian and military vehicles.

Recommendations:

- Carry out a comprehensive survey for grazing lands, especially with regard to ownership and productivity.
- Ban ploughing of grazing lands completely.
- Manage grazing lands by the Ministry of Agriculture as grazing reserves subject to all regulations of grazing reserves.
- Ban the cutting down of trees.
- Define areas allocated for military purposes and close other areas, preventing vehicle movement, except on roads designed for that purpose.

Wildlife species. Some species of wildlife plants are threatened as a result of overuse, including those used for food, clothing or decoration.

Recommendations:

- Wildlife plants should only be used to provide seeds for breeding on special farms; these seeds should be collected only with permission from an authorized agency. Examples of such plants are thyme and camomile.
- Wildlife animals should not be used, except by permission from a specialized authority and within the limits of international agreements and Jordanian environmental regulations regarding the breeding of these animals. Specialized authorities are assigned to the Ministry of Agriculture, the RSCN and the Jordanian universities as scientific consultants.
- Encourage the establishment of special hunting areas where birds and animals are bred, to alleviate pressure on other areas and give animals there a chance to breed undisturbed.

Haphazard recreation. Increasing continuously in Jordan and causing great damage to wildlife, especially in forests.

Recommendations:

- Define recreation zones in various areas in Jordan and establish the necessary services for visitors. Ban recreation in areas not allocated for that purpose, and prepare a touristic map of recreation sites in co-operation with the Ministry of Tourism.
- Introduce the concept of wildlife protection in educational programmes at all levels of education; encourage the establishment of nature protection clubs in schools and societies.
- Encourage publications related to wildlife animals and plants for all levels of readers.
- Encourage scientific research related to wildlife and habitat.
- Issue regulations and laws necessary to carry out these recommendations.

7 TOP PRIORITIES: NEW RESERVES & ENVIRONMENTAL EDUCATION

The arid-land ecology of Jordan is vulnerable to unplanned development and inappropriate use, and its capability to withstand environmental pressures is limited. Jordan's system of nature reserves offer the best hope for preserving remnants of the country's natural heritage.

Nature reserves. These are established and managed by the RSCN. The RSCN completed a study outlining the establishment of 12 nature reserves covering all environmental and climatic areas in Jordan and its wildlife animals and plants. Seven such reserves have been established so far (including those under development). The committee recommends that the establishment of reserves be continued and their protection and management be supported. The Council of Ministers has approved this initiative. Specifically, there are three reserves which warrant top priority during implementation of the NES: Wadi Rum, Dana, and Burqu.

7.1 Rum Wildlife Reserve Project (Proposed)

Description of project. *Rum Wildlife Reserve*, is located in southern Jordan at 35° 25' E. Long. by 29° 35' N. Lat. The reasons for the proposed action are: to carry out a bio-physical survey of the area; derive management plans for the reserve and its sub-areas; construct protective fencing in selected sub-areas; and translocate 50% of the Arabian oryx (*Oryx leucoryx*) herd which now inhabit the Shaumari Wildlife Reserve. The project will be implemented by the Royal Society for the Conservation of Nature, Jordan. Estimated cost: JD 481,200 or US \$700,000.

Project objective. It is the intention to relocate approximately 50 oryx of the one hundred head which inhabit Shaumari Wildlife Reserve. One prime objective is to minimize loss by disease, hunting and over-grazing, which are the main problems for the area. The Rum area is generally considered to be a suitable habitat for oryx but more precise fieldwork must be

done to identify the suitability of specific sub-areas and the quality of the habitat, particularly during the hot, dry season.

Project elements (Phase 1):

- Preparation of baseline land-use map (airphotointerpretation).
- Survey of flora and fauna, multi-seasonal (fieldwork, plus some a.p.i.).
- Preparation a facilities plan.
- Preparation of management plans.
- Public consultation and awareness campaign.
- Tourism planning.
- Establish Rum nature reserve and wildlife reserve.
- Oryx re-introduction programme.

Benefits. (i) The protection of diverse fauna and flora, representing southern Jordan; (ii) environmental rehabilitation of areas currently over-grazed; (iii) enlarging the herd of oryx; (iv) increasing public awareness in the area; and (v) contributing to the tourist potential of Wadi Rum.

7.2 Dana Wildlife Reserve Project (Proposed)

Description of project. Dana Wildlife Reserve is located at E. Long. 35° 31' by N. Lat. 30° 35'. The objective of the project will be to protect the diversity of indigenous flora and fauna in the area, to attract tourism and to encourage social development of the area. The Jordanian implementation organization will be the Royal Society for the Conservation of Nature. Approximate cost: JD 300,000 or US \$440,000.

Project elements:

Phase 1 (capital assets):

- The renovation of Dana village; building of information centre and headquarters and establishment of campsites.
- Preparation of baseline land-use map (airphotointerpretation).
- Survey of flora and fauna, multi-seasonal (fieldwork, plus some a.p.i.).
- Preparation a facilities plan.
- Preparation of management plans.
- Construction and equipping of four stations/posts.
- Land titling and survey.
- Fencing of vulnerable areas.
- Communications system.
- Transportation.
- Renovation of deserted houses.

Phase 2:

- Construction of breeding enclosures.
- Renovation of occupied houses.
- Providing basic services.
- Preparation of camping site.
- Production of educational materials.
- Training.

Benefits: to protect and conserve the diversity of fauna and flora, to re-introduce some endangered species such as ibex and leopard, and to raise public awareness among different types of people. Socio-economic benefits include the encouragement of tourism and the creation of local employment opportunities.

7.3 Burqu Wildlife Reserve Project (Proposed)

Description of project. Burqu Wildlife Reserve is located in northeastern Jordan at E. Long. 37° 55' by N. Lat. 32° 40'. The project objectives are to protect and preserve representative

areas of the eastern desert (Burqu Hammda) and to re-introduce some endangered species such as the oryx, ostrich, and cheetah. The project will be implemented by the Royal Society for the Conservation of Nature, Jordan. Estimated cost: JD 250,000 or US \$368,000.

Project elements (Phase 1):

- Preparation of baseline land-use map (airphotointerpretation).
- Survey of flora and fauna, multi-seasonal (fieldwork, plus some a.p.i.).
- Preparation a facilities plan.
- Preparation of management plans.
- Fencing.
- Building headquarters.
- Re-introduction programme.
- Training local people.

Benefits: (i) to protect fauna and flora represented in the area; (ii) to establish a trans-boundary biosphere reserve between neighbouring countries; (iii) to increase public awareness of the importance of the area; (iv) to generate income through tourism; and (v) to improve social conditions in the area through direct and indirect employment.

7.4 Rehabilitate Azraq Oasis

Azraq Oasis was designated a *Ramsar Site* in 1977. Although it manifests clear signs of environmental stress, it still represents a wetland of great ecological, economic and social value, meeting several of the criteria established under the Convention for identifying wetlands of international importance.

Unfortunately, a recent monitoring evaluation reveals that its ecological character has deteriorated over the past decade, largely as a result of groundwater extraction. It is abundantly clear that unlimited exploitation of the Azraq basin's water will lead to the ultimate destruction of that resource through salinization. Only the timing of such an occurrence is in any doubt. Hence, over-exploitation will lead not only to the disappearance of an ecologically outstanding area, but also to the loss of the considerable benefits which the wetland provides to the people of Jordan. As a first "emergency" step, every effort should therefore be made to ensure that no further deterioration occurs. As a follow-up step, a management plan should be prepared for restoring Azraq's ecological character, at least to the level which existed as little as 10 years ago.

This deteriorating situation leads to the following specific recommendations (Jones, T.A. and J.E. Clarke. 1990):

(1) If the ecological character of the oasis at the time of Ramsar designation is ever to be restored, the present level of water exploitation must be reduced considerably. Recommendation C.3.8 of the Regina Ramsar Conference should be recalled in this connection.

(2) In any event, the total annual exploitation of Azraq's water must not exceed the "safe yield" identified by the Jordanian government.

(3) Further studies, perhaps in conjunction with experts having experience of similar situations in other semi-arid/arid countries, should be done to confirm the validity (in terms of wetland conservation) of the above-mentioned "safe yield" value of 20 MCM per year.

(4) Extraction from private wells should be strictly controlled. Although some have been capped, withdrawals from private wells continue to considerably exceed the quota set by the Jordanian government.

(5) Urgent steps should be taken to evaluate the volume of water being consumed by the military base at Azraq.

(6) The instructions issued by the Ministry of Agriculture should be implemented and strictly enforced.

(7) Flow from the Shishan Springs (which provides an indication of groundwater stability as well as the basis of the Wetland Reserve's ecology) should not be allowed to diminish any further and should, if possible, be increased.

(8) The possibility of using small quantities of water from the middle aquifer to supplement spring flow into the Wetland Reserve, as suggested by the Ministry of Water and Irrigation, should be pursued. Subject to the completion of satisfactory EIAs, such a measure could make an extremely important contribution to the maintenance of surface water in the area of greatest ecological importance.

(9) Detailed hydrological and geological research should continue in order to achieve as complete an understanding as possible of the aquifer systems underlying Azraq. In particular, comprehensive feasibility and environmental impact studies should be undertaken prior to the construction of groundwater re-charge tanks on the wadis feeding the oasis (as suggested by the Ministry of Water and Irrigation). In this connection, it should be noted that Recommendation C.3.5 of the Third Conference of Contracting Parties to the Ramsar Convention (Regina, 1987) related specifically to international development agencies and stated: "... the Bureau should carry out the following activities: ... 4. requesting Development Agencies to provide the Convention Bureau with information on measures they have taken to integrate environmental aspects at all stages of projects affecting wetlands, including their planning and implementation, and monitoring the effectiveness of these measures."

(10) Efforts should be made to ensure that water distribution in Jordan is as efficient as possible; i.e. that loss during distribution is minimized. Research and investment should continue in order to identify and exploit potential new sources of water which could help meet the country's ever-increasing consumption.

(11) A management plan for Azraq Wetland Reserve should be drawn up and implemented at the earliest possible opportunity, in order to make the best possible use (in conservation terms) of the reduced spring flow. Conder's 1979 management plan could be used as the basis for such work, but would need considerable revision in light of the ecological changes which have occurred in the past decade.

(12) Regular ecological monitoring should be undertaken within the Ramsar site in order to determine the effects of future exploitation of groundwater.

7.5 Environmental Education

The goal of conservation education is to improve natural resource management and reduce environmental damage. It tries to: (i) help people become aware of the value of natural resources and the ecological processes that maintain them; (ii) show people what threatens the well-being of their environment and how they can contribute to its improved management; (iii) motivate people to do what they can to improve environmental management. The task of meeting all three of these objectives distinguishes conservation education from other types of instruction.

Conservation education, then, is needed whenever one wants to see a change in how the environment is used. It is a practical tool to achieve observable results. Conservation education programs frequently identify attitude change as their ultimate goal. Attitude change, however, is only the beginning of improved natural resources management. New attitudes do not always lead to new behaviour; therefore, the conservation educator's task is not over unless people channel their new attitudes toward appropriate environmental action. If they do, then the conservation education program is a success.

There are six steps that must be followed by implementers in Jordan if conservation education programs are to be effective. These steps are:¹²

¹²Source: International Institute for Environment & Development (IIED) and United States Fish & Wildlife Service.

- Identifying specific environmental problems that the education program will focus upon and finding the technical solutions to these problems;
- Identifying and becoming acquainted with the intended audience of the program. This could be several audiences: local pastoralists, rural residents of local communities, Jordanian tourists from Amman, and school children.
- Working out the message to be directed at this audience; or messages in the case of several audiences.
- Choosing the various means to communicate this message: radio, TV, audio-visual, written materials, meeting presentations, field trips; travelling exhibitions and other means.
- Establish visitor information centres in all reserves.
- Evaluating and altering the program when necessary.

7.6 Conservation Education School Clubs

The RSCN actively promotes the establishment of Conservation Education Clubs in the schools. Technical and financial assistance is needed to enable them to achieve these goals:

- Holding regular, ongoing training sessions for the interested supervisors, school principals and teachers.
- Establish more camps for spreading and strengthening environmental awareness among schoolchildren.
- Facilitate field trips for clubs and allocate symbolic prizes.
- Hold national contests for the clubs; award symbolic prizes.
- Exhibit the clubs' achievements in special or joint exhibitions on the level of the departments.
- Prepare an annual plan for nature protection clubs, including participation in local and international celebrations, activities and occasions concerning environment.
- Prepare an overall plan in co-operation with the Ministry of Education covering all mass media (newspapers, magazines, radio, and television). This would include a pamphlet issued by the RSCN outlining environmental guidelines, with lessons and activities to help nature protection clubs promote the concepts of nature protection.

Description of Project: Procurement of Mobile Unit for Environmental Education. Public awareness of conservation and nature is prerequisite to changing attitudes and behaviour towards the environment, particularly with respect to water, forests, and wildlife. In order to expand its Conservation Education Clubs Programme, RSCN needs a fully equipped Mobile Unit outfitted with an audio-visual slide projector, generator, a screen and other information equipment. By these means, staff and equipment can have access to schools throughout the Kingdom.

Jordanian implementation organization: the Royal Society for the Conservation of Nature. Approximate cost range: JD 50,000.

8 – CONCLUSION

It is clear that economic and industrial growth disturbs the balance of the environmental system. Establishing nature reserves and preparing a wildlife conservation strategy is the guarantee for attaining a sound wildlife system in accordance with development projects and plans.

Protecting wildlife guarantees the sound and planned use of natural resources without endangering the environmental balance and biological diversity.

Wildlife protection has acquired great importance at the local and international levels. In Jordan's five-year development plan for the years 1986-1990, the environment appeared for the first time as an independent sector. Jordan became a member state of CITES and was a signatory to the RAMSAR Wetlands Protection Convention.

The coming phase requires issuing national environmental legislation to guarantee the safety of life-supporting systems in Jordan and to decrease the dangers to them by

controlling all processes that could affect them. Jordan's limited resource base, increasing population and tenuous water availability mean that our system is fragile and will deteriorate unless we start serious protection and conservation measures.

9 INFORMATION SOURCES FOR WILDLIFE AND HABITAT

9.1 Noteworthy Research and Technical Documents

Noteworthy research and reference documents have been grouped. A complete record of individual documents is kept by the RSCN and the Strategy Secretariat, Department of Environment:

- Abu Ja'far, Maher and Muhammad Balqar. Paper entitled "An Introduction to Wildlife Management in Jordan". (Abu Ja'far, c/o the RSCN; Balqar, c/o Aqaba Region Authority).
- Abu Sammur, Hasan and Suleiman Hanbali. Paper entitled "Climatic Description and Geography of Jordan" in Arabic. (Abu Sammur c/o University of Jordan; Hanbali, c/o Department of Environment).
- Agricultural Economics and Planning Department. (August, 1989). Agricultural Statistical Indicators 1981-1988, in Arabic and English. Statistics Division, Ministry of Agriculture. Amman.
- Agricultural Economics and Planning Department. Agricultural Statistics for the Years 1974-1980, in Arabic. Statistics Division, Ministry of Agriculture.
- Ahmad, Abdullah A. (1989). "Nature Conservation", Chapter 5 in *Jordan Environmental Profile-Status and Abatement*. Amman, Jordan.
- Al Eisawi, Dawud, Ahmad Disi and Alia Hatoug. Study No. 9 entitled "Wildlife in Jordan", in Arabic. University of Jordan.
- Al Eisawi, Dawud. Study No. 8 entitled "Vegetation in Jordan". Faculty of Science, University of Jordan.
- Disi, Ahmad and Alia Hatoug. Study No. 6 entitled "The State of Wildlife Animals in Jordan". Faculty of Science, University of Jordan.
- Disi, Ahmad and Alia Hatoug. Study No. 7 entitled "Birds", in Arabic. Faculty of Science, University of Jordan.
- El-Azzeh, Shehadeh. Paper entitled "Investment Projects in Wildlife and Habitat", in Arabic. Ministry of Tourism and Antiquities.
- El-Azzeh, Shehadeh. Paper entitled "Medical Use of Wildlife Plants" in Arabic. Ministry of Tourism and Antiquities.
- IUCN-UNEP-WWF. (1991). *Caring for the Earth, A Strategy for Sustainable Living*. Gland, Switzerland and Nairobi, Kenya.
- Jones, T.A. and J.E. Clarke. (1990). "Azraq Oasis, Jordan". RAMSAR Convention Monitoring Procedure (Report No. 16). IUCN/IWRD, Gland, Switzerland.
- List No. 1-A entitled "List of Publications", and list No. 1-B entitled "Major References Used".
- List No. 2 entitled "Titles of Noteworthy Research in the Field of Wildlife".
- Lists No. 3-A and 3-B entitled "Environmental Factors Affecting Snake Distribution in Jordan".
- List No. 4 entitled "Grazing Reserves Established by the Ministry of Agriculture".
- List No. 5 entitled "Grazing Reserves Established by the Co-operative Corp."
- Ministry of Municipal and Rural Affairs and the Environment. (1989). "Wildlife" (Chapter on Wildlife in Jordan, pages 183-197) in *State of the Environment (Arabic)*. Edited by Sufyan Tell and Yaser Sara. Amman, Jordan.
- RSCN. *The Birds of Jordan* (1990). Amman, Jordan (with coloured prints; in Arabic).
- Tadrus, Kamal. Paper entitled "Vegetation in Jordan", in Arabic. Ministry of Agriculture.

9.2 Noteworthy Maps and Charts

- Barham. (1986). Table, Animal Resources Development in Jordan.
- Eisawai. (1983). Map of Plant Groups in Jordan.
- Jordan Co-operative Organization. List of grazing reserves.
- Kalmbert. (1972). Map of Plants for Jordan.

- Kasapligil. (1956). Map of Plants for Jordan.
- Long. (1957). Climatic and Environmental Map of East Jordan.
- Ministry of Agriculture. List of grazing reserves.
- Photomosaics of Azraq. Hunting Technical Surveys, England.
- Royal Society for the Conservation of Nature. List of established nature reserves and proposed reserves.
- Table. (1986). Grazing Sites Productivity in Jordan.

Maps Available at the Royal Geographic Centre:

- Azraq Map, scale 1:50,000.
- Climatic Atlas of Jordan.
- Map of the Kingdom, scale 1:250,000.
- Ministry of Agriculture. Distribution of Forest Guards in Jordan.
- Ministry of Agriculture. Distribution of Forests in Jordan.
- The Badia Map. (1988).

Other sources for maps include these institutions:

- Department of Lands and Surveying.
- Jordan Valley Authority.
- Ministry of Agriculture, Forests Division.
- Wadi Hammad Basin Project.
- Zarqa River Basin Project.

ANNEX 1 – LIST OF TABLES FOR WILDLIFE & HABITAT

Table 1 – Grazing Reserves Established by the Ministry of Agriculture
(Excludes Azraq Desert Grazing Reserve, established jointly by the RSCN and Department of Forests)

<i>Name of Reserve</i>	<i>Location</i>	<i>Year Established</i>	<i>Area in Dunums*</i>	<i>Annual Rainfall (mm)</i>
Twaneh	Tafila	1981	20,000	150
Ae'sheyeh	Ma'an	1983	20,000	100-120
Eira	Balqa	1986	20,000	200
Adasiya	Amman	1983	20,000	200
Ma'in	Madaba	1983	20,000	200
Wadi Butum	Zarqa	1986	15,000	75
Ras Naqab	Ma'an	1986	12,000	120
Lajoun	Karak	1981	11,000	150
Sabha	Ma'raq	1979	10,539	150
Fujeij	Ma'an	1958	10,000	200
Mujib	Karak	1981	9,763	150
Nekhil	Karak	1987	7,000	180-200
Khanasiri	Ma'raq	1946	4,545	220
Rajib	Ajloun	1983	4,500	200
Surra	Ma'raq	1946	3,961	180
Dab'a	Amman	1968	3,000	120
Mansheieh	Ma'an	1968	3,000	150

*One dunum = 1,000 square metres, or 10 ares, or 0.1 hectare, or 0.247 acres.

Table 2 - Grazing Reserves: Location, Area and Rainfall

<i>Name of Reserve</i>	<i>Location</i>	<i>Total Area (Dunums)</i>	<i>Annual Rainfall (mm)</i>
Khanasiri	Ma'raq	4,545	220
Surra	Ma'raq	3,961	180
Sabha	Ma'raq	10,539	150
Dab'a	Amman	3,000	120
Wadi Butum	Amman	15,000	75
Mujib	Karak	9,763	150
Lajjoun	Karak	11,000	150
Nekhil	Karak	7,000	180-200
Twaneh	Tafila	20,000	150
Fujeij	Ma'an	10,000	200
Mansheieh	Ma'an	3,000	150
Ae'sheyeh	Ma'an	20,000	100-120
Ras Naqab	Ma'an	12,000	120
Rajib	Ajloun	4,500	200
Eira	Balqa	20,000	200
Adasiya	Amman	20,000	200
Ma'in	Madaba	20,000	200

Table 3 - Nature Reserves Established by the RSCN

<i>Name of Reserve</i>	<i>Location</i>	<i>Year Established</i>	<i>Area in Dunums*</i>	<i>Annual Rainfall (mm)</i>
Wadi Rum	Aqaba	1989	560,000	50-100
Azraq Desert Reserve	Azraq	1987	320,000	50-100
Wadi Mujib	Madaba- Karak	1987	212,000	150
Dana	Tafila	1989	150,000	350
Shaumari	Azraq	1975	22,000	50-100
Zubia	Ajloun	1988	13,000	500
Azraq (wetland)	Azraq	1977	12,000	50-100

*One dunum = 1,000 square metres, or 10 ares, or 0.1 hectare, or 0.247 acres.

Table 4 - Latitude and Longitude of Nature Reserves		
<i>Name of Reserve</i>	<i>North Latitude</i>	<i>East Longitude</i>
Abu Rukba	31° 08'	35°53'
Azraq	30° 52'	35°49'
Bayir	30°46'	36° 41'
Burqu	32° 42'	37°57'
Dana	30° 37'	35°32'
Jabal Mas'ada	30°10'	35°18'
Jafer	30°17'	36° 08'
Jarba	30° 15'	35°40'
Rum	29 ° 35'	35°25'
Shaumari	31°48'	36° 49'
Wadi Mujib	31° 27'	35°48'
Wadi Rajil	31° 54'	37°12'
Zubia	32° 25'	35°45'

ANNEX 2 – IUCN RECOMMENDATIONS ON USE OF WILDLIFE AND PROTECTION OF BIOLOGICAL DIVERSITY IN PARKS¹³

A-2.1 Conservation of Wildlife through Wise Use as a Renewable Natural Resource (from Resolution 18.24)

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

1) AFFIRMS that ethical, wise and sustainable use of some wildlife can provide an alternative or supplementary means of productive land-use, and can be consistent with and encourage conservation, where such use is in accordance with adequate safeguards, namely:

- a) sound, scientifically-based monitoring mechanisms to ensure that such use is maintained at levels which can be sustained by the wild populations without adversely affecting the species' role in the ecosystem or the ecosystem itself;
- b) compliance with national and international legal obligations and policies;
- c) provision for the protection of wild animals from avoidable cruelty and suffering;

2) URGES all countries to:

a. establish an adequate system of protected areas as an adjunct to the development of sustainable wildlife use programmes to further ensure the conservation of the species involved in such programmes.

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

1) UPHOLDS the sustainable use of wild animals for human benefit as in keeping with the World Conservation Strategy;

2) URGES that, when a wild animal is captured and/or killed, it is done in a sustainable and human way, based on an understanding of the ecology of the species concerned, and without adverse consequences for the conservation of other species, the integrity of ecosystems or the achievement of other conservation objectives, which may include the strict protection of national parks.

A-2.2 Protection of Biological Diversity in National Parks and other Protected Areas (from Resolution 18.27)

RECALLING that national parks and other protected areas serve a wide range of purposes, as recognized by IUCN through the work of the Commission on National Parks and Protected Areas;

AWARE, however, that the existing national parks and other protected areas are often poorly representative of native biotas and ecosystems;

CONCERNED that opportunities to protect biological diversity are being rapidly diminished by global development;

RECOGNIZING AND SUPPORTING existing efforts to protect biological diversity;

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

1. EMPHASIZES that the protection of biological diversity, including species and habitat richness, representativeness and scarcity, is a fundamental principle for the identification, management and public enjoyment of national parks and other protected areas;

CALL UPON national governments, state governments, international agencies and the nongovernmental community to establish and support the principle, implementation and practice of the protection of biological diversity as a prime reason for the establishment, maintenance and expansion of systems of national parks and other protected areas.

¹³Source: Resolutions & Recommendations from the 18th Session of the General Assembly of IUCN–The World Conservation Union, Perth, Australia, Dec. 1991.

ANNEX 3 – INFORMATION ON WORKING GROUP

A-3.1 Current membership of working group w/list of administration appointments

H.E. Anis Mouasher	Chairman, RSCN
Eng. Maher Abu Ja'far	General Director, RSCN
Mr. Suleiman Hanbali	Asst. Director of NES, DOE
Prof. Dr. Ahmad Ed-Disi	UOJ, Faculty of Science
Prof. Dr. Dawud Al Eisawi	UOJ, Faculty of Science
Dr. Abdelmagid Tell	UOJ, Faculty of Agriculture
Dr. Alia Hatoug	UOJ, Faculty of Science
Dr. Isam Shunnaq	Yarmouk Univ., Science Dept.
Dr. Kamal Tadrus	Ministry of Agriculture, Head of Ranges Research Div., NRC
Mr. Shihadeh M. Azza	Ministry of Tourism, Dir. of Parks

A-3.2 Current List of On-Call Members

Prof. Dr. Subhi Qasim	University of Jordan
Dr. Muhammad Shakhatreh	Ministry of Agriculture
Prof. Dr. Barakat Abu Rmeileh	University of Jordan

ANNEX 4 – INFORMATION ON KEY SOURCES OF SECTORAL KNOWLEDGE

A-4.1 Names and Addresses of Informed Persons**Jordanian experts in flora and vegetation**

Prof. Dr. Subhi Qasim	Plant Protection
Prof. Dr. Dawud Al Eisawi	Classification and Protection
Dr. Kamal Tadrus	Ranges and Protection
Dr. Esam Shunaq	Flora Environment
Dr. Jamil Lahham	Classification
Dr. Ahmad El-Oqleh	Forests and Classification
Eng. Maher Abu Ja'far	Management of National Parks and Forests
Dr. Mahmoud Juneidi	Management of Waterfalls, Forests and Ranges
Dr. Saleh Share'	Forests
Mr. Shihadeh M. Azza	Planning and Park Management IUCN Regional Councillor

Foreign experts in flora, protected areas and bio-diversity

V. H. Heywood	IUCN, England
Fakhri A. Bazaz	Harvard Univ., USA
Jim Thorsell	IUCN, Switzerland (Protected Areas)
Jeff McNeely	IUCN, Switzerland (Bio-Diversity)

Jordanian experts in animals and animal habitat

Prof. Dr. Ahmad Ed-Disi	Vertebrates
Dr. Alia Hatoug	Mammalian Ecology
Dr. Ibrahim Abu Yaman	Insects
Mr. Anis Mouasher	Birds

Foreign experts in animals and animal habitat

D. Harrison	Mammalogist, England
B. Nelson	Ornithologist, England

Environmental education experts

Dr. Muhammad Sabarini	Yarmouk Univ., Education Department
Dr. Isam Shunnaq	Yarmouk Univ., Science Dept

A-4.2 List of Government and Non-Government Agencies with Interests in Wildlife, Habitat and the Environment

Within Jordan

- | | |
|---|------------------------|
| • Department of Environment | MMRA&E, Amman |
| • Ministry of Agriculture (various departments) | Amman |
| • Royal Society for the Conservation of Nature | Jabal Amman |
| • Faculty of Agriculture | Univ. of Jordan, Amman |
| • Faculty of Sciences | Univ. of Jordan, Amman |
| • Department of Science | Yarmouk Univ., Irbid |
| • Aqaba Region Authority | Aqaba |
| • Ministry of Education, Nat'l Comm. for Education, Culture and Science | Amman |
| • Ministry of Tourism, National Parks Dept. | Amman |
| • Ministry of Health, Environmental Health Section | Amman |
| • Mu'ta University | Karak |
| • Higher Council for Science and Technology | Amman |
| • Jordanian Society for the Control of Environmental Pollution | Amman |
| • Society for the Control of Desertification and <i>Badia</i> Development | Amman |

International

- | | |
|-------------------------------------|--------------------|
| • IUCN-the World Conservation Union | Gland, Switzerland |
| • World Wide Fund for Nature (WWF) | Gland, Switzerland |

ANNEX 5- ANIMALS IN JORDAN

A-5.1 Selected List of Mammals

Threatened and very rare mammals

• <i>Procavia capensi</i>	Rock hyrax
• <i>Scirurus anomalus</i>	Red squirrel
• <i>Mellivora capensis</i>	
• <i>Meles meles</i>	
• <i>Hystrix indica</i>	Indian crested porcupine
• <i>Gazella dorcus</i>	Mountain gazelle
• <i>Gazella subgottrosa</i>	Goitered gazelle
• <i>Capra ibex</i>	Nubian ibex
• <i>Panthera pardus</i>	
• <i>Martes foina</i>	
• <i>Caracalia caracalia</i>	
• <i>Lutra lutra</i>	
• <i>Myocastor coypus</i>	

Mammals vanished from Jordan during the past 120 years

• <i>Equus hemionus hemionus</i>	Onager
• <i>Oryx leucoryx</i>	Oryx
• <i>Capreolus capreolus</i>	Roe deer
• <i>Dama dama mesopotamica</i>	Persian fallow deer

Re-introductions

• <i>Oryx leucoryx</i>	Oryx
• <i>Equus hemionus hemionus</i>	Onager
• <i>Capreolus capreolus</i>	Roe deer

A-5.2 Selected List of Birds

Common birds in Jordan: owls, sparrows, buntings, plovers, wagtails. Re-introduced species of birds: blue-necked ostrich, which was restored by the RSCN after vanishing from Jordan in 1965.

Threatened species

• <i>Pterocles alchata</i>	Pin-tailed sandgrouse
• <i>Fulica atra</i>	Coot
• <i>Ammodramus heyi</i>	Sand partridge
• <i>Chlamydotis undulata</i>	Houbara bustard
• <i>Milvus milvus</i>	

• <i>Anas platyrhynchos</i>	Mallard
• <i>Ciconia ciconia</i>	White stork
• <i>Burhinus oedicnemus</i>	Stone curlew
• <i>Alectoris chukar</i>	Chukar partridge
• <i>Falco peregrinus</i>	Peregrine falcon
• <i>Francolinus fran colinus</i>	Black or Francolin partridge
• <i>Gypus fulvus</i>	Griffon vulture
• <i>Neophorn percnopterus</i>	Egyptian vulture

A-5.3 Selected List of Reptiles

There are two orders of reptiles in Jordan: (1) *Chelonia* and (2) *Squamata*, which is divided into two sub-orders: (a) lizards and *Chamaeleo chamaeleon* and (b) snakes.

Species of threatened reptiles

• <i>Chamaeleo chamaeleon</i>	Chamaeleon
• <i>Testudo graeca</i>	Tortoise
• <i>Uromastix aegyptius microlepis</i>	Dabb
• <i>Varanus griseus</i>	Desert monitor

A-5.4 Selected List of Amphibia and Fish

There are four species of amphibia belonging to four families; *Bufonidae*, *Hylidae*, *Ranidae* and *Pelobatidae*.

Species threatened due to deterioration of suitable environment

• <i>Aphanius serhani</i>	• <i>Millepora dichotoma</i>
• <i>Cypraea pantherina</i>	• <i>Panulirus versicolor</i>
• <i>Eremochetys imbricate</i>	• <i>Pelobates syriacus</i>
• <i>Fungia</i> sp.	• <i>Pomacanthus imperator</i>
• <i>Gymnothorax javanicus</i>	• <i>Priacanthus hamrur</i>
• <i>Linckia</i> sp.	• <i>Siphonochallina siphonela</i>

In addition to the above there are 18-20 species of freshwater fish and 1000 marine fish species in the Gulf of Aqaba.

ANNEX 6 – PLANTS IN JORDAN

A-6.1 Selected Endemic, Rare, Threatened and Extinct Species

List of some endemic plants in Jordan

- | | |
|--------------------------------------|------------------------------------|
| • <i>Alyssum spinosum</i> | • <i>Iris edomensis</i> |
| • <i>Anthemis tenuicarpa</i> | • <i>Iris nigricans</i> |
| • <i>Astragalus azragensis</i> | • <i>Iris petrana</i> |
| • <i>Colchicum tunicatum</i> | • <i>Iris postii</i> |
| • <i>Convolvulus jordanesis</i> | • <i>Iris vartani</i> |
| • <i>Cousinia austrojordanica</i> | • <i>Kickxia azragensis</i> |
| • <i>Crocus moabiticus</i> | • <i>Onopordum transjordanicum</i> |
| • <i>Daphne linearifolium</i> | • <i>Onosma aaronsohnii</i> |
| • <i>Diplotaxis villosa</i> | • <i>Plantago maris-mortui</i> |
| • <i>Eremostachys transjordanica</i> | • <i>Psoralea flaccida</i> |
| • <i>Ferula sinaica</i> | • <i>Salvia paratica</i> |
| • <i>Haplohyllum poori</i> | • <i>Verbascum transjordanicum</i> |
| • <i>Herniaria acrochaeta</i> | |

Selected rare plant species in Jordan

- | | |
|---------------------------------|------------------------------|
| • <i>Acer pseudo-platanus</i> | • <i>Micromeria sinaica</i> |
| • <i>Anisosiadium lanatum</i> | • <i>Opoponax hipsidum</i> |
| • <i>Atraphaxis spinosa</i> | • <i>Roemeria procumbens</i> |
| • <i>Biarum eximium</i> | • <i>Roulea</i> sp. |
| • <i>Carakkuma</i> sp. | • <i>Scandix palaestina</i> |
| • <i>Cytinus hypocistis</i> | • <i>Scandix turgida</i> |
| • <i>Daucus jordanicus</i> | • <i>Seetzenia lanata</i> |
| • <i>Ducrosia flabellifolia</i> | • <i>Smyrniium connatum</i> |
| • <i>Globularia arabica</i> | • <i>Ulmus</i> sp. |
| • <i>Lappula barbata</i> | • <i>Zoegea purpurea</i> |

Selected threatened species of plants in Jordan

- | | |
|-------------------------------------|----------------------------|
| • <i>Acacia gerrardii</i> | • <i>Orchis collina</i> |
| • <i>Capparis decidua</i> | • <i>Orchis punctata</i> |
| • <i>Ducrosia flabellifolia</i> | • <i>Orchis sancta</i> |
| • <i>Epiactis veratrifolia</i> | • <i>Orchis simia</i> |
| • <i>Helianthemum sanctiantonii</i> | • <i>Polygala sinaica</i> |
| • <i>Himantoglossum affine</i> | • <i>Rhamnus dispermus</i> |
| • <i>Lasioppermum brachyglossum</i> | • <i>Stenbergia lutea</i> |

- *Ophrys apifera*
- *Ophrys oestrifera*
- *Ophrys sphegodes*
- *Ophrys transhyrcana*
- *Sternbergia clausiana*
- *Tragopogon collinus*
- *Trigonella moabitica*
- *Zygophyllum propinquum*

Selected extinct species of plants in Jordan

- *Abutilon indicum*
- *Anacamptis pyramidalis*
- *Avicennia marina*
- *Hyphaene thebaica*
- *Orchis laxiflora*
- *Orphus vernixia*

This resolution was subsequently adopted by the Second World Conference on National Parks held in Yellowstone and Grand Teton National Parks, 1972.

In general, exploitation of natural resources must be prohibited in an area which is to be included within Category II. Exploitation is taken to include agricultural and pastoral activities, hunting, fishing, lumbering, mining, public works construction (transportation, communications, power), and residential, commercial or industrial occupation.

It is recognized that within the boundaries of certain national parks there are existing villages, towns, communication networks, and the ongoing activities connected with them. Provided that these areas do not occupy a significant part of the land and are in reality zoned and so arranged that they do not disturb the effective protection of the remaining area, they will not be considered as a basis for exclusion from this category.

It is also recognised that management activities may be necessary and desirable for maintenance of the desired flora and fauna, to maintain public access and facilities, and for the purposes of administration and management of the area.

Effective zoning is an important tool for avoiding conflicts of interest v protected areas. At the 11th General Assembly of IUCN at Banff in 1972, it was agreed by CNP that sites designated as national parks should include areas here designated as "strict natural zones", "managed natural zones", and "wilderness zones". In addition, they could appropriately contain areas of the kind here designated as "protected anthropological zones", or "protected historical or archaeological zones".

However, national parks must be available for public visitation. This use, it was agreed, could be combined with the primary function of nature conservation through a system of zoning. In this, one zone would be established in which roads or other means of access may be constructed, buildings or other structures to accommodate tourism and park administrative functions may be located, and appropriate recreational facilities may be placed. This special tourism/administrative zone would not be one designated primarily for nature conservation, but would be so delimited and located as to create minimum interference with the nature conservation function of the park. National parks can also satisfy the public visitation function by establishment of wilderness areas over all or part of the national park, thus providing for limited tourism of a special kind.

To qualify as a national park in the IUCN sense therefore, an area may consist of various combinations of zones as follows:

- Wilderness zone only.
- Wilderness zone combined with strict natural zone, managed natural zone or both.
- Any or all of the above zones combined with a tourist/administrative zone.
- Any or all of the above zones combined with one or more zones classified as anthropological, archaeological or historical.

A-7.3 Category III: Natural Monument/Natural Landmark

This category normally contains one or more of several specific natural features of outstanding national significance which, because of uniqueness or rarity, should be protected. The specific feature to be protected ideally has little or no evidence of man's activities. These features are not of the size nor do they contain a diversity of features or representative ecosystems which would justify their designation as a national park. Size is not a significant factor; the area only needs to be large enough to protect the integrity of the site.

Although Category III areas may have recreational and touristic value, they should be managed to remain relatively free of human disturbance. These areas may be owned and managed by either central or other government agencies or non-profit trusts or corporations as long as there is assurance that they will be managed to protect their inherent features for the long term.

A-7.4 Category IV: Managed Nature Conservation Reserve/Wildlife Sanctuary

A category IV area is desirable when protection of specific sites or habitats is essential to the continued well-being of resident or migratory fauna of national or global significance. Although a variety of areas fall within this category, each would have as its primary purpose the protection of nature; the production of harvestable, renewable resources may play a secondary role in the management of a particular area. The size of the area is dependent upon the habitat requirements of the species to be protected. These areas could be relatively small, consisting of nesting areas, marshes, lakes, estuaries, forests, or grassland habitats, or fish-spawning areas or seagrass feeding beds for marine mammals.

The area may require habitat manipulation to provide optimum conditions for the species, vegetative community, or feature according to individual circumstances. For example, a particular grassland or

heath community may be protected and perpetuated through a limited amount of livestock-grazing; a marsh for wintering waterfowl may require continual removal of excess reeds and supplementary planting of waterfowl food; or a reserve for an endangered animal may need protection against predators. Limited areas may be developed for public education and appreciation of the work of wildlife management.

Ownership may be by the central government or, with adequate safeguards and controls, by lower levels of government, non-profit trusts or corporations or private individuals or groups.

A-7.5 Category V: Protected Landscape or Seascape

The scope of areas that fall within this category is necessarily broad because of the wide variety of semi-natural and cultural landscapes that occur within various nations. This may be reflected in two types of areas: those whose landscapes possess special aesthetic qualities which are a result of the interaction of man and land; and those that are primarily natural areas managed intensively by man for recreational and touristic uses.

In the former case, these landscapes may demonstrate certain cultural manifestations, such as customs, beliefs, social organization, or material traits as reflected in land use patterns. These landscapes are characterized by either scenically attractive or aesthetically unique patterns of human settlement. Traditional land use practices associated with agriculture, grazing, and fishing are dominant. The area is large enough to ensure the integrity of the landscape pattern.

The latter case often includes natural or scenic areas found along coastlines and lake shores, in hilly or mountainous terrain, or along the banks of rivers, often adjacent to tourist highways or population centres. Many areas will have the potential to be developed for a variety of outdoor recreational uses with national significance.

In some cases the area may be privately held and the use of either central or delegated planning control would be necessary to ensure the perpetuation of both the land use and lifestyle. Government assistance might be required to improve the standard of living while maintaining the natural quality of the site through appropriate management practices. In other instances, the areas are established and managed under public ownership, or a combination of public and private ownership.

A-7.6 Category VI: Resource Reserve (interim conservation unit)

Category VI areas will normally comprise an extensive and relatively isolated and uninhabited area having difficult access, or regions that are lightly populated, yet may be under considerable pressure for colonization and greater utilization. In many cases, there has been little study or evaluation of these areas, so the consequences of converting these areas to agriculture, extracting mineral or timber, constructing roads, or using them for intensive fishing, dredging or mariculture is unclear. Similarly, use of the resources may not be appropriate, because of lack of technology, human or financial resource restrictions, or alternative national priorities. Consequently, natural, social, and economic values are not sufficiently identified to permit the area to be managed for specific objectives or to justify its conversion to other uses. On land, restricted access is implied, so areas will normally require control, depending upon the pressures to enter and utilize the area. Areas may be owned or administered by government or public corporations.

Maintaining existing conditions to allow for studies on the potential use for the designated areas is a prerequisite. No exploitation should occur, for use of resources by indigenous inhabitants; ongoing ecologically sound activities are acceptable.

This category has also been used within the CMC database for those areas which are protected by legislation, but where, for various reasons, there is no infrastructure and protection is reportedly inadequate.

A-7.7 Category VII: Natural Biotic Area/Anthropological Reserve

Category VII areas are natural areas where the influence or technology of modern man has not significantly interfered with or been absorbed by the traditional ways of life of the inhabitants. These areas may be remote and isolated, and their inaccessibility may be maintained for a considerable period of time. The societies are of particular significance to the maintenance of cultural diversity; there is a strong dependence of man upon the natural environment for food, shelter, and other basic materials to sustain life. Extensive cultivation or other major modifications of the vegetation and animal life is not permitted.

Management is oriented towards the maintenance of habitat for traditional societies to enable them to continue within their own cultural mores.

A-7.8 Category VIII: Multiple-Use Management Area

A Category VIII area is large, containing considerable territory suitable for the production of wood, water, pasture, wildlife, marine products and outdoor recreation. Parts of the area may be settled and may have been altered by man. The area may possess nationally unique or exceptional natural features, or may as a whole represent a feature or area of international or national significance.

Planning programmes to ensure the area is managed on a sustained yield basis is a prerequisite. Land ownership is under government control. Through proper zoning, significant areas can be given specific additional protection. For instance, the establishment of wilderness-type areas is consistent with the purpose of these areas, as would be establishing nature reserves. Multiple use, in the context of Category VIII, is considered to be the management of all renewable resources, utilized in some combination to best meet the needs of the country. The major premise in the management of these areas is that they will be managed to maintain the overall productivity of the areas and their resources in perpetuity.

A-7.9 Category IX: Biosphere Reserves

One focus of the Unesco Man and the Biosphere Programme, initiated in 1970, is to conserve representative natural areas throughout the world through the establishment of a network of biosphere reserves.

Management objectives are to conserve for present and future use the diversity and integrity of biotic communities of plants and animals within natural ecosystems, and to safeguard the genetic diversity of species on which their continuing evolution depends. Biosphere reserves provide opportunities for ecological research, particularly baseline studies, both within natural and altered environments. These reserves have particular value as benchmarks or standards for measuring long-term changes in the biosphere as a whole and are consequently important sites for environmental monitoring. Biosphere reserves provide facilities for education and training.

Each biosphere reserve will include one or more of the following representative examples of natural biomes: unique communities or areas with unusual natural features or exceptional interest; examples of harmonious landscapes resulting from traditional patterns of land use; and examples of modified or degraded ecosystems capable of being restored to more natural conditions.

A biosphere reserve must have adequate long-term legal protection. Each biosphere reserve is large enough to be an effective conservation unit, and to accommodate different uses without conflict. Each reserve must be approved by the Man and the Biosphere International Co-ordinating Council before it can receive designation as a biosphere reserve.

Each biosphere reserve will be zoned to provide direction for its management. Four zones may be delineated as follows: natural or core zone; manipulative or buffer zone; reclamation or restorative zone; and stable cultural zone.

A-7.10 Category X: World Heritage Sites (natural)

The International Convention concerning the Protection of the World Cultural and Natural Heritage (Unesco, 1972) provides for designating areas "of outstanding universal value" as World Heritage Sites. These exceptional areas must be recommended by the signatory nation responsible for the site for declaration by the International World Heritage Committee. The sites include many previously designated protected areas.

Management objectives of World Heritage Sites are: to protect the natural features for which the area was considered to be of world heritage quality; to provide information for world-wide public enlightenment; and to provide for research and environmental monitoring.

Areas to be considered under the Convention will be restricted to those which are truly of international significance. Natural sites must represent one or more of the following criteria:

- Be outstanding examples representing the major stages of the earth's evolutionary history
- Be outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment
- Contain unique, rare or superlative natural phenomena, formations or features or be areas of exceptional natural beauty and
- Be habitats where populations of rare or endangered species of plants and animals still survive.

Natural Heritage Sites must also fulfil conditions on the integrity of the site. Management of these sites stresses the maintenance of the heritage values, ensures the continuation of legal protection, and promotes the significance of each site to the country, its people and the world.

All sites have strict legal protection and are owned by the government or a non-profit corporation or trust for the long term. While recreation and on-site interpretation will generally be developed, some sites may be of such significance that public use will either be strictly controlled or prohibited.

5 • Coastal & Marine¹⁵

This chapter identifies coastal and marine life resources, causes of depletion affecting them now and in the future, and ways to control depletion. It also addresses the issue of land-use planning. In Jordan, coastal and marine environment encompass the Gulf of Aqaba and the Dead Sea.

Aqaba Coast. The Jordanian sector of the Aqaba coast is 27 km long, and is located in the vicinity of north latitude 29° 30' by east longitude 35° 00'. The coastal boundaries extend from the high tide mark on the east coast to the international boundary midway across the Gulf towards the coasts of Israel and Egypt. The rift system which continues to fracture and split the once integral Arabian-African plate divides at the juncture of the Gulf of Suez and the Gulf of Aqaba. This fault zone, the Gulf of Aqaba-Dead Sea Rift, extends 600 km north to the Zagros-Taurus mountains in Turkey.

Dead Sea Coast. The Dead Sea is situated between longitudes 35° 15' and 35° 35' east and latitudes 30° 13' and 31° 47' north. It is 55 km long. The boundary between Jordan and Israel bisects the Dead Sea.

1 SUMMARY LIST OF ISSUES

1.1 First Priority

<i>Development-related:</i>	<i>Environment-related:</i>
<ul style="list-style-type: none">• Ballast water• Bulk material dust• Expansion of ports & industry• Industrial gas emissions• Industrial wastes• Management of hazardous wastes• Oil pollution• Receding of Dead Sea	<ul style="list-style-type: none">• Conservation of marine reserves• Environmental authority• Environmental awareness & information• EIA and monitoring system• Environmental legislation• Management of coastal zone• Marine life• Marine park• Water transparency

Management of hazardous wastes. The government of Jordan agreed on April 19th, 1989, to join the Basel Convention for the control of hazardous waste trans-boundary transport. The government declared the Kingdom's lands an area forbidden to foreign hazardous wastes, and addressed the Convention's General Secretariat, advising all member states of that declaration. No hazardous wastes are received anywhere along the Jordanian coast.

Industrial gas emissions. Table 1, Annex 1 shows types, quantities and treatment of gases emitted from the industrial sector. Note that all emitted gases and dusts are within the permissible limits and EPA specifications.

Ballast water (tankers). The Aqaba Gulf lacks the installations necessary for treatment of ballast water which ships, especially oil tankers, need in varying quantities to maintain their balance. Initially, the port of Aqaba was not engaged in oil export and import. However, the port began handling Iraqi oil products in 1984, creating a need for these services in the port. Lack of ballast water facilities is considered a shortcoming in the ability to fulfil required procedures for ensuring environmental protection.

¹⁵Information in this Chapter was prepared by the Coastal Committee, under the Chairmanship of Mr. Bassam Kakish, Chairman, Aqaba Region Authority.

Industrial wastes. Several large industrial installations were established during the last ten years at the south end of the coast near the Saudi border, with plans to expand some of these industries in the near future. The present installations are:

- a) the industrial compound of the Phosphate Mines Co.
- b) the thermal power plant of the Jordan Electricity Authority.
- c) installations for handling, storing and loading potash of the Arab Potash Co., which also imports basic materials such as ammonia, sulphur and fuel oil, and exports finished products such as potash and fertilizers.

The industrial compound produces the main industrial wastes in Aqaba, consisting of sulphur filtration wastes and gypsum wastes.

Three-hundred seventy-five thousand tons of crude sulphur are used to produce H_2SO_4 of 98.5% concentration. The melted sulphur is filtrated, a process which produces solid mass wastes containing 62% sulphur. These wastes are collected within the boundaries of the compound. Their quantities are estimated at 1600 tons/yr and although they are not presently used, the possibility of selling them locally is under consideration.

Gypsum wastes are the by-product of phosphoric acid production, and consist of:

$CaSO_4 \cdot 2H_2O$	95.0 - 97.0%
P_2O_5	1.5 - 2.0%
Fluorides	1.0%
SiO_2	1.0%

The quantities of gypsum wastes from the industrial compound reach 1,850,000 tons/yr and are disposed of in a small valley southeast of the compound, 6 km from the sea. In addition to these wastes, quantities of crude materials are emitted during transport, storing and handling, despite the availability of dust-filtering equipment. Sulphur emitted during the unloading of ships and transport by trucks is estimated at 0.001%. Aluminium hydroxide emitted during truck transport from the port to the factory is estimated at 0.02%.

Water transparency. The Aqaba Gulf portion of the Red Sea is characterized by particularly pellucid waters. Absence of water turbidity arises from the small quantities of suspended particulate matter in the water column, including low nutrient levels; and limited cloud cover, concomitant with minimal rain, which limits coastal soil erosion and other effluent runoff. Light penetration in the Gulf averages 70 metres. These factors provide the requisite conditions for optimal growth of coral strata observed in the Gulf of Aqaba.

Conservation of marine environment reserves. The Jordanian coast includes three areas which have been designated as marine reserves. These areas were selected from an environmental study which determined regions of high coral density. The three reserves include the lands adjacent to and behind the coast-sea interface. One of the three reserves has been clearly defined and bounded by the Marine Park authorities. Fishing and other activities have been banned at the site. The other two sites will be publically granted reserve status in the next two years. The Marine Park designations were included in the 1976 organization plan of the Jordanian coast by the Aqaba Region Authority, which manages the existing park.

Receding of Dead Sea. The Dead Sea is an important reservoir for obtaining certain crude materials and chemicals, and its surface level is estimated at 407 m below sea level. The sea is "drying up"; in 1920 its surface was 392 m below sea level and has been gradually dropping ever since. Earlier this century, the area of the Dead Sea was 1050 km², and its maximum length and width were 80 km and 17.5 km, respectively. At present, the area has shrunk to 660 km². The Dead Sea is divided into two basins separated by an area of land called Lisan. The northern basin's area is almost 76% of the total area and the southern basin's depth is only 10 m.

The Dead Sea is an internal sea or saline lake, fed by the Jordan River and its tributaries, as well as by runoff from the side valleys like Wadi Mujib and Wadi Araba. As a result of the diversion of water sources that historically flowed into the Dead Sea, the quantity of water pouring into the Dead Sea has decreased markedly over the past two decades. In

addition, evaporation of the Dead Sea's water resource has continued unabated due to high temperatures which characterize the Jordan Valley. This has led to a marked recession of the Sea.

Water budget studies carried out by the Water Authority indicate that the rate of surface and groundwater replenishing the Dead Sea from the western and eastern shores is estimated at 450 million m^3 /yr. In order to maintain its present level, the Dead Sea annual requirement is approximately 1250 million m^3 , which is equivalent to its annual surface water evaporation. The Dead Sea therefore needs an additional water input of 800 million m^3 /yr.

The Jordan Valley Authority is currently preparing a major plan to develop local and international tourism along the Dead Sea coast. The plan identifies suitable areas, and describes the electricity, water and road infrastructure, as well as means for encouraging the private sector to establish appropriate tourist and treatment facilities.

Any plans for developing the Dead Sea coast should consider a Dead Sea water-recession monitoring system, the salt reclamation and potash industries, and water harvest projects.

1.2 Second Priority Issues

- Israeli naval activities.
- Thermal pollution.
- Illegal removal of corals.
- Accumulation of wind-borne paper wastes and plastics, on beaches and the sublittoral.
- Denigration of aesthetic characteristics of the coast.

Naval activities: military activities of the Israeli Naval Forces contribute to pollution and environmental degradation. Depth charges exploded daily decimate marine life. Plastic or polystyrene bags are used as shooting targets for medium and heavy machine guns, and they finally sink to the bottom of the sea.

There are facilities in Eilat military port for maintaining small naval vessels. Sometimes, waste oil leakages from them can be observed clearly in waters, especially when the wind is westerly. The Hebrew writing on flotsam washing up on Jordanian beaches, such as bags and empty cans, show that a percentage arrives from Eilat.

2 OVERALL EVALUATION OF SECTORAL RESOURCES

2.1 Tourism in Aqaba

Aqaba is considered a basic element of international tourism in Jordan, with its beaches and proximity to Petra and Wadi Rum. Prior to the 1990-91 season, tourism in Aqaba had witnessed considerable growth, for example, 1989 figures were 30% greater than those for 1987. If this growth rate resumes, there will need to be an increase in the number of hotel rooms by at least 608 rooms by 1993.

Table 2 shows the number of hotels operating in Aqaba, their classification, numbers of rooms and beds, and employees. Table 3 shows the hotels under construction in Aqaba, although in the aftermath of the Gulf crisis some of these projects have been put on hold.

It is clear that the number of tourists—especially Arab tourists and northern European charter tour groups (Finns)—has increased in the past few years. This phenomenon, reflected in Table 4, requires an increase in tourist facilities such as a managed marine park, and calls for improving standards of services in restaurants, clubs, water sports and recreational fishing.

At the local level, the Aqaba Region Authority implements projects in the priority fields of (i) mother and child health, (ii) housing and public utilities and (iii) water and food security. With respect to tourist investment, the Authority recognizes the necessity for

developing tourist projects in the southern coastal area, between the Marine Science Station and Coast Guard Station, by involving the private sector (see Figure 2, *Proposed Tourist Development*). The main projects to be capitalized by the private sector are:

- a) Marine Centre project.
- b) Marine Park project.
- c) Sultan Qabus tourist suburb project.
- d) Beach Club and Village project.
- e) International Hotel Compound No. 1.
- f) International Hotel Compound No. 2.

Human pressure on the coastal and marine, coastal and marine environment will continue to increase. Prompt action on the legislative front and field level management will be vital to controlling the negative environmental impacts.

2.2 Marine Life Resources

Marine plants of floating organisms, benthic algae and sea grasses comprise the main source of nutrition in the marine environment. The quantity of animal life depends on these plants and their reproduction capabilities.

The coral community is also an important source of nutrition in the marine environment, since coral tissues contain microscopic plants capable of food production. Table 5 shows the various types of marine life in the Aqaba Gulf.

Aqaba Gulf productivity is considered low, relative to that in open seas; the quantity of bottom algae does not exceed 25 g dry/m²; seaweed quantities range from 100-400 g dry/m². Grazing processes work to decrease those quantities; however, the fast renewal growth compensates for them. Productivity ranges from 11-1326 g carbon/m² annually, compared to 500-2500 g carbon/m² annually found in other seas. Low nutritive productivity also applies to sea floating organisms. It does not exceed 12 g carbon/m². The living weight does not exceed 44 mg/m² of water.

The low productivity affects the size of the fish population, which is low, despite its great variation. There may also be some measure of indirect phosphate pollution in Aqaba Gulf, which would lead to the following:

- Increased growth of algae, to the disadvantage of corals, with a resulting increase in sedimentation.
- Increased secretion of coral algae and the gathering of bacteria, which cause coral disease and death.
- Change of *labroides dimidiatus* fish communities.
- Increased potential for *holothuroidea* reproduction.
- Decreased light to levels below those required for the growth and hardening/calcification of corals.

Fisheries in Aqaba. Coral reefs and fish are more public in the southern part of the Aqaba Gulf where it opens to the Red Sea in the vicinity of the Tiran islands. Areas where water basins link are characterized by their richness in nutrient salts; this is due to water exchange, which increases nutritive productivity, and with it fish wealth. The low productivity of fisheries in Jordan's Gulf Sector is due to the following:

- a) Compared to other areas, the narrow Jordanian regional waters are poor in nutritive salts. As industrial sites expand, the available in-shore area for fishing decreases.
- b) The narrow band of coral reef growth, makes certain modern fishing techniques impossible, so fishermen resort to methods like hooks, *sakhtui* and nets.
- c) The reluctance of fish to eat in their breeding seasons makes hook-and-line fishing unsuccessful, because fish are not attracted by bait.
- d) The area's 70 licenced fishermen cannot afford to purchase the specialized fishing equipment to catch the types of fish available in the different seasons.
- e) Banning of fishing methods, including the use of explosives and sedative chemicals.

General remarks by fishermen and others indicate a sharp decrease in quantities of fish suitable for human consumption (Table 6, Annex 1). Many marine species such as the turtle are disappearing from the gulf waters and the coral groups have been decreasing or destroyed due to various human activities, including tourism, shipping and industries. Individual destructive practices such as uprooting corals and using illegal fishing techniques also take their toll. The near-shore sublittoral zone reveals an accumulation of litter waste, cans and bottles, old fish traps and sunken lines.

The Aqaba Region Authority, in co-operation with Nice University, made a study of the Jordanian coast by remote sensing after 1986. This study should now be repeated in light of prevailing conditions, in order to estimate the size of various impacts on the marine environment.

2.3 Population Resources

There are 50,000 people living in Aqaba. Most of them work in industry or land and sea transport. Some of them also work in fishing; there are 70 licenced fishing boats.

The studies adopted by the Aqaba Region Authority for planning and structural organization of the city show that the population of Aqaba is expected to reach 119,000 in the year 2000, and 178,000 in the year 2005, as shown in Table 7.

2.4 Transport & Trade Resources

Transport by land and sea to and from Aqaba is considered the most important current use of the coast. Marine transport has developed since the beginning of the seventies; the volume of goods transported through the port increased from 1,200,000 tons in 1972 to 20,000,000 tons in 1989. Figure 1 (Annex 1) illustrates the location of the main port, container port and industrial compound in the south. Figure 1 illustrates the location of the main port, container port, and industrial compound in the south.

The installations and quays used for maritime activities now occupy more than 30% of the total length of the Jordanian coast in Aqaba Gulf. The Ports Corporation has 18 special quays for moving goods like phosphate, potash, sulphur, cement, fertilizers, chemicals, petrol products, oils, wood, cereals, heavy equipment and many other commodities. Statistics from 1989 showed 2.23 metric tons of phosphate transported by railroad and 4.35 metric tons by truck.

The movement of ships in Aqaba port has increased considerably; the number received at the port in 1989 was 2446 ships, whereas it was only 327 ships in 1972. This increase in the movement of ships and the nature of goods transported, parts of which might be spilled in the gulf water, certainly affect marine life and coasts.

However, the extent of this effect and its time limits and results depend to a large extent on many factors such as water current movement, the speed and direction of wind, the nature of spilled material and the preventive measures taken to control their effects.

There is a need for a comprehensive, accurate evaluation process of the extent of environmental imbalance prevailing now and that expected to occur in the future due to using the coasts for transport and navigation operations, including storage and handling. The aim of such an evaluation would be to determine what should be done over the long run and to draw up and develop practical frameworks with the least possible negative impacts.

This applies also to using the coastal road for transporting goods to and from the sea or to the industrial installations there. The increased number of trucks and the volume of goods transported due to the increased maritime traffic may have a negative effect on the coastal environment, especially in areas overlooking the sea. This requires a field study and practical evaluation before any preventive measures are taken.

3 CAUSES OF COASTAL RESOURCE DEPLETION—DESTRUCTIVE PRACTICES AND PRESSURES

A number of practices and pressures adversely affect marine life of the sub-littoral. To identify the impacts of these practices and measures, comparative longitudinal studies have to be carried out for any target area. Among the most important of these practices are: dredging resulting from coastal installations like ports; phosphate dust from bulk exports; collecting corals and shells, oil spills and the change in the composition of nutritive salts as a result of bulk materials dissolving in water.

3.1 Coastal Installations

The Aqaba Region Authority monitors and controls construction of coastal installations to control their effect on marinelife. Despite the importance of establishing ports for both economic and social considerations, the destruction resulting from them in the form of burying seabed communities should not be overlooked. Before selecting a site for such an installation, a study must be carried out to assess the importance of the site touristic its recreational, tourist, scientific and environmental protection aspects.

Building new ports has direct and indirect impacts. Water carries sediments from the construction site to the neighbouring areas, where they accumulate gradually over the sea bottom. Research has shown that such sedimentation of particulate matter decreases coral growth in the surrounding areas and causes its death by smothering it. The same sediments also close coral pores and obstruct eating and breathing, weakening the coral's ability to fight the growth of other living organisms over its surface, such as soft coral, algae and sponge, which are less sensitive to sediments than the coral itself.

The speed of coral growth renewal depends on many factors, among them the degree of destruction that occurred, the distance of coral from the surrounding areas which were not affected by the destruction, and the time when the destructive physical factors stopped. Theoretically, if sedimentation stops, corals can regain their natural state completely; however, the actual conditions in Aqaba show otherwise. Continuous small pressures resulting from individual activities prevent total renewal and cause deterioration of the coral reef life. The cumulative effect of small activities like the disturbance of bottom sediments by ships' propellers, waste disposal and spillage of materials from these ships, in addition to obstruction of water currents by coastal installations, gradually destroys living resources. An example of that is what is happening now to mature flora communities.

3.2 Phosphate Dust

The coral reef in the area stretching from south of the port to the marine science station seems to be deteriorating. Hard corals are being replaced by algae and soft corals; sea urchins, whose existence is related to density of algae and low underwater visibility, are increasing.

Phosphate is one of the nutritive elements in the sea, but at high levels it leads to increased growth of algae at the expense of corals. Many types of algae can bear high levels of phosphate, whereas the growth of many other organisms recedes; they might even disappear completely. The increased level of phosphate concentration in the Gulf water threatens the natural balance of living communities.

The phosphate crude under discussion is apatite (calcium fluoro-phosphate), which is not easily soluble in sea water. (However, there are types of algae which are capable of dissolving it, or using it undissolved). This phosphate is called crystal poison. Studies have shown its effect of preventing hardening of corals and shells, in addition to its effect as sedimentation material. This effect is increased by the natural competition for available space between corals, algae and sponges, undesirable because their excessive growth on the coral's surface kills it. The phosphate company should immediately implement the necessary procedures to control emissions of phosphate dust.

Planned Improvements to Reduce Dust Emissions

At the port of Aqaba a choke feeders system is to be installed at the three shiploaders (responsible for the visible emission) in Aqaba Port. Tender documents for the choke feeders system have been finalized by a formed joint technical committees of JPMC and Aqaba Port Corporation (APC). The implementation of the system will be the responsibility of Aqaba Port Corporation, while financing will be arranged through Ministry of Planning.

– Mustafa Salma, Jordan Phosphate Mines Co., (June 1991)

3.3 Pollution by Oil

Ships, navigational activities and port operations—not to mention the oil port in Eilat—are sources of oil leakages into the gulf water. Although no considerable biological effects have occurred so far, it has been indicated that oil is a main cause of the deterioration of the coral reef in Eilat. Oil retards the growth of new corals and kills old ones by obstructing reproduction—specifically, by inhibiting the ovaries' growth and the number of coral pupa produced. The effect of oil on corals depends on the water level and its content of volatile compounds. If the oil spreads at the time of strong tide, it sticks to the coral's tissues, causing death within two hours. Oil, which contains volatile compounds, causes tissue disintegration without direct contact, and affects the animal's feeding pattern. Coastal organisms which live in the tide area are the most affected by the oil. Oil spillage also has a negative impact on tourist activities. The Ports Corp., the Coast Guard, the Aqaba Region Authority and all other concerned agencies should work to prevent sea water pollution by oil, with special emphasis on preventing pollution originating from facilities which handle oil.

3.4 Collecting Corals and Other Living Organisms

It is very important to protect marine plant and animal life environments in Aqaba in order to protect native and rare species there. Native species of plants and animals comprise 10-15% of the total population. Examples of native species are:

- 1) Sea cucumber. *Holothuria proceraspia*, *Stichopus pseudohorrens*.
- 2) Algae. *Turbinaria eilatensis*, *Galaxura* sp.
- 3) Fish. *Gorogasia sillneri*, *Carapus variegates*, *Scorpaenopsis aqabae*, *Thalassoma*, *Klunsiageri*.

The semi-closed location of the Aqaba Gulf and its special environmental conditions separate it from the Red Sea. Temperatures decrease as we go north; the prevailing northern winds lower the water temperature as a result of increased evaporation. They also increase water salinity. These unusual conditions cause the form and composition of living communities to differ greatly from those in the Red Sea. Certain species rare in the gulf are widely seen in the Red Sea, for example *Halichoeres centriquadrus*, *Acanthurus solus* and *Rhinecanthus assasi*.

This difference is continuous and gradual along the coast. Fishermen often kill the rare scorpion fish caught in their nets because they are poisonous and of no commercial value. Such practices damage the bio-diversity and lead to disappearance of rare and native species in the gulf. It is hoped that environmental information and awareness programmes will contribute to decreasing the collection of corals and other marine life forms. However, the responsibility for preventing such practices belongs to the executive authority and staff of the Coast Guard and Public Security.

3.5 Clinker

Clinker results from burning cement ground crudes, and leaves ovens in the form of particles. Table 8 shows the main chemical compounds of clinker. Due to its high concentration of silica and its harmful effects on public health and the environment, it is imperative that a study be carried out to identify the negative impacts of the handling process on the environment, and that recommendations be made to control these impacts and stop the spreading of clinker in the air and in sea water. The Ports Corp. and the Cement Factories Co. should take the necessary measures to control the emission of clinker.

3.6 Thermal Pollution

Industrial installations use sea water to cool hot products, condense vapour and cool hot water. These sea waters do not have contact with any pollutants; they are transferred through non-metal pipes and treated against living organisms by adding chlorine at a rate of 0.5 ppm in accordance with international standards. Upon discharge, the temperature of the cooling water is within 10° C of the ambient temperature. The industrial compound in Aqaba uses 20,000 m³/hr of sea water. The Aqaba Thermal power plant uses 36,000 m³/hr. Both installations employ a continuous monitoring system of sea water that has been used for cooling purposes.

3.7 Storing of Sulphur

Sulphur is exported by private companies through the Aqaba port; it is brought from Iraq by land and stored in Aqaba until exported. The main storing area is two km east of the coast in an area 100 m above sea level and the main road. It is surrounded by a 10 m-high wall. Quantities of sulphur stored in the area, which is 10,000 m², sometimes reach 40,000 tons. The various agencies deal with sulphur very carefully so that no pollution occurs during loading, storing or transport. The Aqaba Region Authority, in co-operation with agencies such as the Ports Corp. and the Ministry of Industry and Trade, is currently considering designating areas for storing sulphur on the back road, far from the beaches, in order to avoid any impacts on the environment.

4 RECOMMENDED ACTIONS FOR COASTAL & MARINE ENVIRONMENTAL MANAGEMENT

4.1 Create an Independent Environmental Authority

Due to the multiplicity of agencies responsible for environmental control in the country and the problems this entails for work procedure, it is necessary for the government to

create an independent authority for the environment that would unify the plans and activities of all concerned agencies within a centralized authority. The tasks of this authority would be to:

- a) Formulate and develop policies, plans and legislation necessary for the protection of the environment.
- b) Supervise the implementation of the national environmental strategy within economic, social and architectural parameters.
- c) Study cases of environmental pollution, identify their causes and co-operate with the concerned official and private agencies to prevent occurrence of accidents and to control them.
- d) Develop means of co-operation, co-ordination and organization of relations between the Environmental Authority and the concerned national, regional and Arab organizations.
- e) Set a general policy to train workers in the field of environmental protection and increase their efficiency.
- f) Require an environmental impact assessment (EIA) before issuing the necessary licences for any given project.
- g) From specialized committees within the authority, each of them would concentrate on one field of environmental affairs, enlisting the help of whomever it finds helpful among experts in the various fields.
- h) Conduct regular periodic inspection of industrial, professional and agricultural establishments to make sure that the necessary environmental conditions, protective measures and public safety considerations are applied.

The Environmental Authority would have a higher council to be called the Environment Protection Council. This council would carry out the following tasks:

- Approve the general policy to protect and improve the environment in the Kingdom.
- Approve general plans and policies for the protection of the environment.
- Cancel or amend any licence issued in accordance with the Law of Environment, if it appears to violate the law or relevant regulations, instructions and decisions.
- Establish co-ordination between environmental requirements and development needs, and relate environmental considerations to planning and development policies at all levels to ensure the continuity of development projects.
- Follow up the environmental cases referred to it.
- Co-ordinate and co-operate with concerned ministries and agencies to draw up a strategy for environmental education and information.
- Discuss and approve the annual budget of the Environmental Authority.

4.2 Environmental Impact Assessment of Marine and Coastal Development Projects (EIA)

EIA is a procedure which aims at identifying the environmental impacts of establishing large development projects such as electric power plants, industries, irrigation operations in large valleys, industrial ports or any other similar development activities. In the case of Aqaba, projects which would warrant an EIA review would be port expansion, fertilizer plant expansion, new highways, city expansion plans and others.

What is an *Environmental Impact Assessment*?

The fundamental objective of development is improvement of the human condition. If that objective is to be met, development must be sustainable. It has become clear that one of the most effective methods of determining and elaborating safeguards for sustainability is to subject development proposals to Environmental Impact Assessment (EIA). A major recommendation, voiced by all the NES Working Groups, to create an EIA system for Jordan.

What is Environmental Impact Assessment?

EIA is the comprehensive and detailed study of a proposed development initiative and the environment within which it is to be developed. The EIA process is integrated within the traditional project planning activities and includes alternatives of both location and technology. Base-line studies are conducted to record the nature and quality of the existing environment. Likely interactions between the development initiative and the environment are then identified and, as far as is possible, quantified.

Ameliorative measures are developed to prevent or minimise any potential adverse environmental impacts identified, and enhance any environmental benefits of the project. Other opportunities for environmental enhancement are also identified at this stage. Finally, a monitoring programme is developed to assess actual impacts and to follow the course of long-term impacts and determine compliance with existing environmental standards.¹⁶

Although the EIA process may most often be applied to development projects, it is equally applicable to development programmes and policies. It can be used in all sectors, e.g. agriculture, industry, energy, mining, urban/rural development, transportation (port, airports, roads) and water. Properly applied, EIA can minimise the depletion of natural resources, and resulting environmental degradation or social disruption that has so often accompanied ill-planned attempts at development. There are numerous examples which can be drawn from Jordan, where the existence of a prior EIA process could have prevented the adverse effects of development.

4.3 Available Legislation Regarding the Marine Environment

Discussion of marine environmental issues aims at protecting it from various hazards, the most important of which is pollution. Addressing this issue requires knowledge of all its aspects. The legal framework is a determining factor in protecting environmental elements and their rational use. Therefore, it is of the utmost importance to have legislation for this purpose. Listed below are the Kingdom's laws related to coastal environment; they are not sufficient, as a whole, to ensure protection:

- a) Ship Law No. 51 of the year 1961, and its amendment No. 25 of 1975.
- b) Aqaba Port Services Fees Law No. 49 of 1976.
- c) Quarantine Law in Aqaba Port No. 32 of 1972.
- d) Circular No. 31 of 1971 regarding wood and wastes discharged by ships into the Aqaba port.
- e) Agreement for regulating mineral oil transit for the Iraqi Petrol Company of the year 1931.
- f) Agreement of partial banning of nuclear tests in the air, atmosphere and underwater, signed in Moscow in 1963.
- g) Agriculture Law No. 10 of 1973.
- h) Fisheries Law No. 25 of 1943 and its amendments.
- i) The proposed Law of the Environment.

4.4 Techniques for Improving Bulk Material Handling

Handling bulk materials involves the possible spillage of some quantities into sea water due to volatility or wrong handling. The procedures now used in this field are not completely effective. Therefore, the control or prevention of bulk material emissions of all

¹⁶One source of impartial advice on establishing an EIA process is the IUCN – The World Conservation Union, attn. Programme officer of EIA Services, Gland, Switzerland.

types—including sulphur, phosphate, clinker and dust resulting from handling crops—will contribute considerably to maintaining water transparency. The best methods for improving bulk-material handling are those which continue over all operations, from production to shipping and export, in the following ways:

Production and industrial sites. These should be sited as far from the coastal zones as possible, with complete adherence to the necessary environmental regulations if using part of the coast for industry proves to be necessary.

Transport operations. Bulk material should be transported in proper vehicles from manufacturing sites to export ports.

Handling operations (loading and unloading). The transporting and handling bulk material without causing marine pollution require many procedures, among them:

- a) Unloading trains and vehicles within closed areas and equipping intakes with volatile dust collectors and equipment to control emissions into the air and the surrounding environment.
- b) Using properly closed and covered handling lines to avoid volatility; one of these lines is the type known as "telescopic conveyer belt".
- c) Requiring exporters to use ships with holds specially designed to store bulk material without causing pollution.
- d) Installing equipment to collect dust on loading equipment.
- e) Preventing transport of bulk material by primitive methods from storage sites inside and outside the port. Transport should be done in special containers.
- f) Continuously cleaning dust from loading and handling areas to prevent it from reaching the coast and water.
- g) Banning storage in uncovered areas and non-specialized yards.
- h) Cleaning equipment used for bulk material transport before leaving the unloading sites.

Improving manufacturing operations. Production companies should take all possible measures, technical and otherwise, to try to separate volatile fine materials during transport, loading and unloading, and make use of the latest available technology to put them in a form allowing their transport and use without pollution. Further research and study are required in this field.

The nature of the Aqaba Gulf contributes to maintaining water transparency; weak sea currents in the gulf prevent the spreading of suspended materials from one area to the other. It has been noticed, for example, that phosphate sinks in the loading area and does not spread to other areas of the Gulf.

4.5 Environmental Detection and Monitoring System in Aqaba

The Aqaba Region Authority, in co-operation with the Royal Scientific Society, started to implement the environmental monitoring system project in Aqaba region from Oct. 1989 - May 1990. The project was restricted to monitoring water quality and included monitoring specific sites of consumable water, sea water, treated waste water, the palm forest irrigation water, and the cooling water of some factories. The project aims at identifying the degree of suitability of effluent from waste treatment plants and of the palm forest irrigation water for various agricultural uses. It also aims at proposing proper irrigation methods and maintaining a record of water quality, to identify the degree of change in it over time and to identify possible results of industrial activity or other negative impacts.

The Marine Sciences Station has been carrying out monitoring activities for the marine environment since 1986 and is still involved in this activity. The full and accurate implementation of this system is important, because it will identify polluting elements of all kinds, especially suspended materials affecting water transparency. It will also continuously investigate the effectiveness of handling methods from the environmental perspective, in order to evaluate and improve them. The Ministry of Planning and the Aqaba Region Authority must provide the necessary financial support if work in this detection system is to continue and be developed to include all environmental elements, including air and solid wastes.

4.6 Environmental Education and Information

The following elements should be reflected in the plan for environmental education and information, to ensure the protection of the coastal zones against pollution:

- a) Formulating educational programmes directed to all levels, showing practices harmful to the marine environment, such as collecting corals and other rare species using explosives and sedative chemicals in fishing, and discharging wastes.
- b) Establishing educational programmes that clarify sound ways of dealing with the marine environment in all its aspects.
- c) Designing informational and educational programmes which clarify the importance of marine environment and conservation.
- d) Encouraging the establishment of voluntary societies in the field of environmental support.

4.7 Hazardous Waste Management

Formulae and plans of action to deal with hazardous wastes in general, and those in coastal areas in particular, must be created. The Kingdom requires a general policy that would include guidelines for laws to guarantee safe monitoring, handling and disposal of hazardous wastes (in accordance with the Basel convention) and would provide for training the technical staff necessary to implement such regulations.

4.8 Marine Reserves

Marine Park. The agreement concluded between the governments of the Hashemite Kingdom of Jordan and the Kingdom of Saudi Arabia in 1964 led to increasing the area of the Jordanian coast in the Aqaba Gulf through a process of land exchange between the two countries. This strip is of the utmost importance for the Kingdom, since it has served as the base for expanding various development activities such as industries, ports and other facilities. Despite the fact that development of the new coast was planned by consultants (GTZ and Dar Handasa) to ensure rational land use, its increased use for transferring goods through the port, especially after the Beirut and Basra ports were closed in 1975 and 1980, respectively, meant that the port expanded at the expense of the natural areas of coast. Other new industries which have developed are: fertilizer, Hussein Power Plant, wood, potash export port, and the oil port.

This development has unfortunately taken its toll on the sea reef all along the coast. However, the government, in co-operation with the Red Sea and Aden Coast Environment Programme of the Arab League Education, Culture and Science Organization, which provided funding, has carried out a study for establishing a marine park on the coast (Ormond 1976). This study was developed later by the Aqaba Region Authority in co-operation with Dar Handasa to organize the uses of the area, by isolating industrial and port areas from tourist areas, connecting those areas to a road network and providing the necessary infrastructure services (water, electricity, roads, telephones). Accordingly, a strip of seven km along the coast was designed to include three marine reserves and a marine park where various tourist services are available hotels, swimming pools, restaurants. (See Figure 2). The Aqaba Region Authority should establish this park as soon as possible, since it will contribute significantly to the area's environmental balance. The authority must ensure that any commercial activities related to industry or transport-ports, storage areas, handling docks and the like are banned within the boundaries of the marine park.

Marine Reserves. As mentioned previously, marine reserves were allocated on the south coast of Aqaba Gulf. Sites of these reserves were selected in accordance with the intensity of coral strata there. These reserves will comprise a sanctuary for the various elements of marine environment, especially corals and fish, and protect them against any human

danger. Each reserve will be surrounded by a land fence and a sea fence which will restrict access to naturalists and researchers. Fishing and boats will also be banned in the reserve.

As a result of the increasing human activity in the coastal areas, the Aqaba Region Authority, in co-operation with all concerned agencies, should start implementing reserve projects as soon as possible (during 1992). The Environmental Authority should set the criteria for managing these reserves. Consideration should be given to designating the entire coast from the Marine Science Station to the Coast Guard Station as a Marine National Park. Within the park several sub-areas could be designated as Marine Reserves (for greater protection), and multiple use areas (to permit development nodes for tourist uses).

A design of a Marine Park would involve specialized training assistance (see Annex 2) in order to ensure effective implementation.

4.9 Coastal Zone Management

The Jordanian coast requires optimal management and use due to its small size and its different functions (tourism, industry, transport, ports), to guarantee that the well-being of one resource does not impinge on the others. In fact, the Aqaba Region Authority prepared an organizational plan in 1985 for the Jordanian coast which considered zoning and expanding various activities. The design of this plan was based on a complete study of the marine environment and its biological, chemical and physical elements, including sea currents and waves, the coral reef, seabed maps and remote sensing. The plan considered decreasing installations adjacent to the coast. Plans were also prepared for eastward expansion far from the coast for all industrial activities, truck compounds and additional docks. A back road would connect these compounds to the other areas. The Aqaba Region Authority is currently investigating alternatives to allow for development that will not lead to deterioration of beaches. The plan also includes continuous monitoring and detection to prevent any kind of pollutant from reaching the sea. By 1984, some damage was evident along 30% of Jordan's coastline. Ports accounted for 75% of the damage; the balance was contributed by industry (7%), tourism (2%) and other activities (16%).

4.10 Wind-Borne Litter

Due to the fact that the prevailing wind direction in the Aqaba area is north-south, many discarded items and plastic bags are carried towards the southern coast. Each government or private agency in Aqaba city cleans its own facilities and installations, and the Aqaba Municipality cleans the city. The Aqaba Region Authority assumes responsibility for cleaning the southern coast through private contracts. To control the spreading of such garbage in the coastal areas, the waste disposal site was transferred to a location 14 km south of Aqaba and around 6 km east of the coast, within a mountainous area, to guarantee that none of these wastes are transferred outside the site.

In order to improve performance in this area, all agencies mentioned above are required to provide more waste receptacles over the coastal area, and to empty them more frequently. The citizens and staff involved in collecting and disposing of these wastes are the target of special information and education programmes. The national camp ground is a source of litter affecting nearby Scuba Diving sites. There needs to be an underwater clean-up campaign near the southern fence as the dive site there is currently garbage-strewn.

4.11 Aesthetic and Scenic Attributes of the Coast

The Jordanian coast in the Aqaba Gulf has two types of beaches, sandy and rocky. The northern sandy beach is the site of tourist facilities such as hotels and beaches for swimming and water-sports clubs. The southeastern rocky beach is dominated by the coral reef, which comprises a unique site in terms of location and the many species of coral and fish and other marine life associated with it. Therefore, it is an important attraction for marine environmentalists and divers. However, the small size of the coast as a whole, and the fact that it is the only outlet of the Kingdom to the sea, means that it will have to serve different

purposes—among them recreation and tourism, shipping, and industry—creating sharp competition for its beaches.

5 INFORMATION SOURCES FOR COASTAL AND MARINE

5.1 Research and Technical Documents

- Ahmad, Abdullah A. (1989). "Marine and Coastal Environment" (Chapter 7) in *Jordan Environmental Profile—Status and Abatement*. Amman, Jordan.
- Far and away the best source for technical documents pertaining to the Gulf of Aqaba is the office of the Aqaba Region Authority, in Aqaba.
- Hulings, Neil C. (1989). *A Review of Marine Science Research in the Gulf of Aqaba*. Marine Science Station. Aqaba, Jordan.
- IUCN-UNEP-WWF. (1991). *Caring for the Earth, A Strategy for Sustainable Living*. Gland, Switzerland and Nairobi, Kenya.
- Ministry of Municipal and Rural Affairs and the Environment. (1989). "Marine Environment" (Chapter on Marine Environment, pages 145-152) in *State of the Environment* (Arabic). Edited by Sufyan Tell and 'Asar Sara. Amman, Jordan.
- The best source for research papers on marine biology is the Marine Science Station in Aqaba and at the two universities which sponsor the station's research work, the University of Jordan (Amman), and Yarmouk University (Irbid).

5.2 Noteworthy Maps and Charts

- Jordan Valley Authority. Dead Sea Shore uses plan.
- Population Densities Plan. Scales 1/5000, 1/25,000.
- Royal Coast Guard. Depth Maps of Gulf Waters. The Aqaba Region Authority, Marine Sciences Station.
- The Aqaba Region Authority. Organizational Plan of Aqaba Southern Coast uses sites, scale 1/10,000.
- The Aqaba Region Authority. Plan for land use and transport of Aqaba and southern coast, scale 1/30,000.
- The Aqaba Region Authority. Remote sensing plan of the southern coast, available at any requested scale.
- The Aqaba Region Authority. Structural Plan of Aqaba till the Year 2000, scale 1/1000.

ANNEX 1 - COASTAL & MARINE, TABLES AND FIGURES

Table 1 - Gases Emitted in the Industrial Compound			
<i>Plant</i>	<i>Emitted Gases</i>	<i>Quantity</i>	<i>Treatment</i>
H ₂ SO ₄	SO ₂	75g/ton of H ₂ SO ₄ produced	These gases are emitted from 60-m-high chimneys.
Phosphoric Acid	Fluorine	10 g/ton of acid produced	The gas is washed with caustic soda.
Fertilizers	Fluorine	13 g/ton of fertilizer produced	Gases are washed in towers, by phosphoric acid and water.
Fertilizers	Ammonia	4 kg/ton of fertilizer produced	
Fertilizers	P ₂ O ₅	4 kg/ton of fertilizer produced	
Aluminium Fluoride	Fluorine	230 g/ton of aluminium fluoride produced	The gas is washed by water in absorption towers.
Aluminium Fluoride	Aluminium Fluoride dust	220 g/ton of aluminium fluoride produced	Dust is treated by special filters.

Table 2 - Capacity of Hotels in Aqaba with No. of Employees						
<i>Hotel</i>	<i>Class</i>	<i>No. of Rooms</i>	<i>No. of Beds</i>	<i>Jordanian Employees</i>	<i>Other Employees</i>	<i>Total</i>
Cazar	3	132	270	25	35	60
Jaber	Economy	12	30	2	2	4
Waha Khadra'	Economy	29	84	3	0	3
Absi	1	21	44	1	3	4
Petra	Economy	28	69	5	2	7
Jamil	1	18	48	4	2	6
Khuli	Pension	12	24	1	2	3
Kornish	Economy	18	50	1	2	3
Manara	1	12	30	2	0	2
Muhandis	Economy	9	22	1	1	2
Quds	Economy	20	60	2	2	4
Yamama	1	14	28	2	2	4
Nahr Khaled	1	18	36	2	2	4
Nu'man	1	18	40	3	2	5
Aqaba	3	96	192	55	39	94
Aquamarina 1	3	63	126	24	36	60
Aquamarina 2	3	110	220	24	36	60
Shate'	1	33	150	2	2	4
Shu'la	2	57	104	4	7	11
Coral Beach	4	92	184	2	54	65
Dhabet	1	20	50	1	3	4
Haya	Economy	10	20	2	1	3
Holiday Internat'l	4a	156	298	69	73	142
Miramar	3	140	250	12	16	28
Nairukh	1	18	39	3	2	5
Palm Beach	Pension	21	65	4	5	9
Qasr Nil	Economy	29	65	15	0	15
Red Sea	1	30	60	3	1	4
Thaghrel-Urdun	Economy	18	35	2	4	6
Zahratel-Urdun	2	30	71	3	3	6
Total		1284	2764	279	339	627

Table 3 - Hotels Under Construction in Aqaba

<i>Hotel</i>	<i>Class</i>	<i>No. of Rooms</i>	<i>No. of Beds</i>	<i>Expected No. of Employees</i>
Khalij Aqaba	4	140	280	60
Aquamarina	3	47	100	20
Nairukh Hadith	3	84	136	35
Shuwaikh	2-3	40	80	8
Jeddah	3	35	70	7
Aqaba Inn	2	48	96	22
Captain	2	25	55	8
Amira	Economy	12	24	5
Jum'a Hammad		-	-	-
Total		431	841	165

Table 4 - Growth of Tourism in Aqaba - From 1987 to 1989

<i>Year</i>	<i>No. of Tourists</i>	<i>Nights Stayed</i>	<i>Arabs %</i>	<i>Foreign %</i>	<i>Arriving by sea <1 day</i>	<i>% Increase in Tourists</i>
1987	21,516	50,798	66.2	33.8	1,773	-
1988	29,402	105,723	77.9	22.1	1,840	36.7
1989	39,705	134,350	75.6	24.4	1,590	35.0
Average/Yr	30,208	99,957	73.2	26.8	1,734	35.9

Table 5 - Marine Life in Aqaba			
Category	Groups Included	# Species	Remarks
Algae	<i>Cyanophyta</i> (blue-green), <i>Chloro.</i> (green), <i>Phaeophyta</i> (brown), <i>Rhodophyta</i> (red)	71	
Sea grasses		3	threatened by disappearance due to sedimentation & navigation
Porifera	<i>Calcarea</i> , <i>Hyalospongia</i> , <i>Demospongia</i> , <i>Sclerospongia</i>	37	
Cnidaria	Soft and hard corals, <i>Crinoidea</i> (sea lilies) & water corals	263	threatened because of uprooting & breaking by anchors
Worms	<i>Nematoda</i> (roundworms), <i>Polychaeta</i> (numerous setae), tapeworms	60	
Mollusca	Shells, <i>Cephalopoda</i> (cuttlefish, squids, octopus)	637	some are threatened by over-harvesting
Echinodermata	<i>Stelleroidea</i> (starfish), <i>Echinoidea</i> , <i>Holothuroidea</i> , <i>Crinoidea</i> (sea lilies)	56	
Crustacea	<i>Malacostraca</i> (crabs, shrimp, lobsters)	200	
Fish		340	
Turtles		2	rare species, need protection
Mammals	Dolphins and sea cows	5	rare species, need protection

Table 6 - Quantities and Types of Fish Caught

Type*	Season	Fishing Technique	Quantity (tons)
Emperor	May-Aug.	Nets & Sakhawi	2
Tuna	Dec.-April	Nets	20
Sardine	June-Aug.	Nets	20
Bigeye	April-Aug.	Nets	0.5
Siganus	April-Aug.	Sakhawi	2.5
Friden	April-Aug.	Nets & Sakhawi	3
Mullid	May-Aug.	Nets	0.5
Squirrel fish	May-Aug.	Nets	0.5
Mullet	Oct.-Jan.	Sakhawi & Nets	0.5
Fusilier & Jack	April-Aug.	Nets	4
Other types, over 25 in number	April-Aug.	Nets	4

*These fish are seasonal, except for the tuna, which are palagic, and the bigeyes, the fusilier and the Jack, which are native.

Table 7 - Population of Aqaba City and Rural Areas - 1979 to 2005

Year	Total Population		
	Aqaba	Rural Areas	Aqaba Region
2005 (projected)	178,000	20,400	198,400
2000 (projected)	119,000	17,200	136,200
1990 (estimates)	55,100	12,200	67,300
1985 (estimates)	46,350	9,950	56,300
1979 (census)	27,000	6,084	33,084

Sources: for 1979: the comprehensive census of population and households. For 1985 and 1990: estimates of Aqaba Region Authority/consultants. For 2000 and 2005: projections of Aqaba Region Authority/consultants.

Table 8

Compound	Crude Material Mixture %	Clinker %
Silica (SiO ₂)	12.5	21.0
(Al ₂ O ₃)	3.6	5.6
(Fe ₂ O ₃)	1.9	3.0
Calcium Oxide (CaO)	40.8	63.3
Magnesia (MgO)	2.5	3.9
Sulphur tri-oxide (SO ₃)	0.6	0.9
Potassium Oxide (K ₂ O)	0.6	0.9
Sodium Oxide (Na ₂ O)	0.1	0.2

Figure 1 – Jordan's Coastal Zone, Gulf of Aqaba

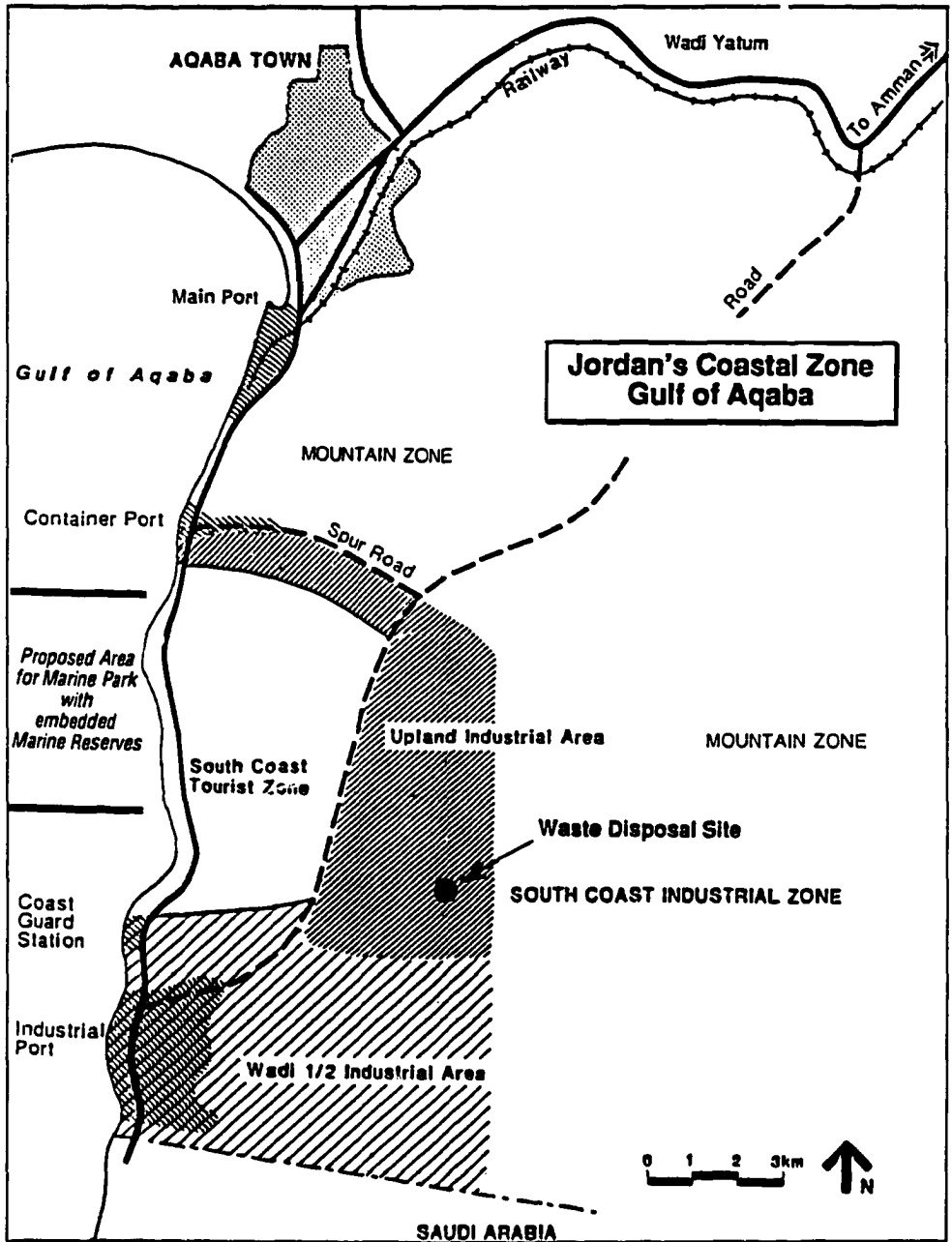
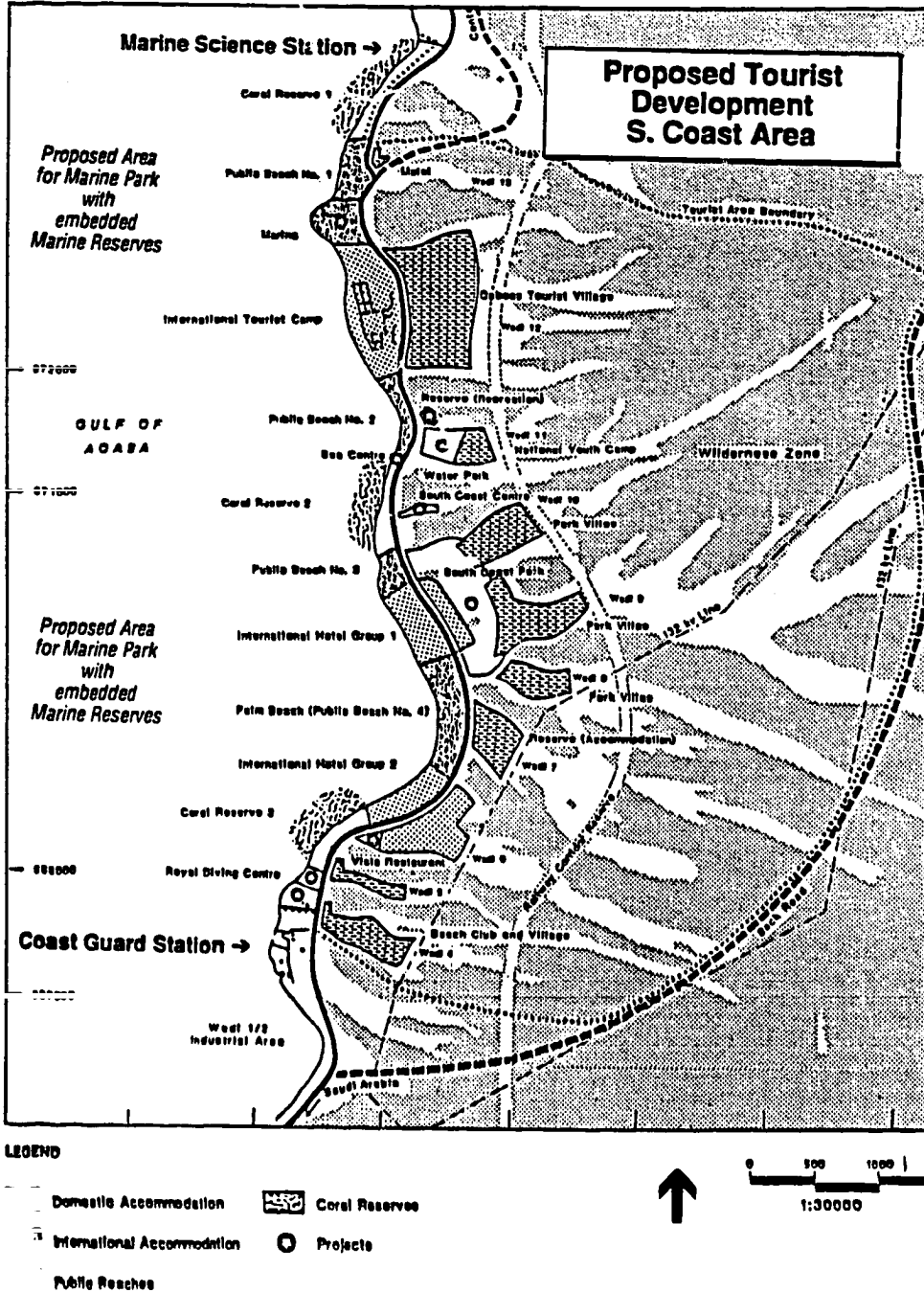


Figure 2 – Proposed Tourist Development, S. Coast Area



ANNEX 2 – IUCN RECOMMENDATION ON TRAINING FOR COASTAL AND MARINE ENVIRONMENTAL MANAGEMENT (SELECTED PART)¹⁷

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

1. CALLS upon national governments, international agencies and the non-governmental community concerned with uses of the marine environment and resources to:

a. implement integrated training strategies to assist managers to achieve the protection of the coastal and marine environments of the world, through the provision of expertise in training, management, surveillance, monitoring, enforcement and maintenance at levels appropriate for the full range of objectives of marine conservation and marine protected areas....

c. establish logistic and financial arrangements for marine conservation, to provide effective initial and follow-up training for management staff.

2. FURTHER RECOMMENDS to all governments...that:

a. the following goal be adopted:

"To ensure that marine protected areas and conservation schemes for the protection of coastal and marine environments are managed by expert staff trained in the range of specialist skills required for those tasks"....

d. the (staff) training programme should have the following objectives:

i. to ensure that those responsible for policy advice and the supervision of management of marine conservation schemes are aware of:

- the nature of marine systems;
- the nature of human use and impacts upon those systems;
- techniques for planning and management;
- the legal and technical requirements for enforcement of legislation;
- the technical requirements for supervision of monitoring programmes;
- the technical requirements for supervision of programmes for education and public contact;
- the technical requirements for use and maintenance of equipment.

ANNEX 3 - INFORMATION ON WORKING GROUP

A-3.1 Current Membership of Working Group

Name	Organization
Mr. Bassam Kakish, (Chairman) (Military Sciences)	Chairman, Aqaba Region Authority
Dr. Dureid Mahasneh, (Rapporteur) (Marine Environment Physiology)	Secretary General, Aqaba Region Authority
Eng. Hussein Khasawneh (Marine Engineering)	Commander, Coast Guard
Eng. Nijm Hammadi (Chemical Engineering)	Deputy General Manager, Phosphate Co.

¹⁷Source: resolution 18.33 of *Resolutions & Recommendations from the 18th Session of the General Assembly of IUCN-The World Conservation Union*, Perth, Australia, Dec. 1991.

Eng. Sami Amarnah (Chemical Engineering)	Director, Safety and Security, Potash Co.
Eng. Ghazi Odat (Chemical Engineering)	Head, Air Protection Section, Department of Environment
Eng. Ramzi Batayneh (Environmental Engineering)	Researcher, Water Section, Department of Environment
Eng. Ghazi Sabri (Mechanical Engineering)	Director, Power Plant Dept., Electricity Authority
Mr. Shafiq El Ashqar (Industrial Management)	Export Director, Phosphate Co.
Mr. Mansour Qaisi (Environmental Monitoring)	Head, Marine Inspection Section, Ports Corp.
Mr. Muhammad Mughrabi (Business Administration)	Rep., Fishermen's Society
Mr. Abdullah Abu Awali (Chemical Marine Sciences)	Studies Dept., Aqaba Region Authority
Eng. Muhammad Al-Hjouj (Chemical Engineering)	Public Safety Officer, Industrial Compound

ANNEX 4 – KEY INFORMATION SOURCES

A-4.1 Names of Govt. and Non-Govt. Agencies

- Aqaba Region Authority, Aqaba, Jordan.
- Arab League Education, Culture and Science Organization.
- Arab Potash Co., Amman, Jordan.
- Department of the Environment, Ministry of Municipal, Rural Affairs & the Environment, Amman, Jordan.
- Higher Council for Science and Technology, Amman, Jordan.
- IOC, UNESCO.
- IUCN–The World Conservation Union, Coastal and Marine Programme.
- Jordan Phosphate Mines Co., Amman, Jordan.
- Jordan University of Science and Technology, Irbid, Jordan.
- Jordanian Electricity Authority, Amman, Jordan.
- Jordanian Ports Corp.
- Marine Sciences Station, Aqaba, Jordan.
- Mu'ta University, Karak, Jordan.
- Royal Scientific Society, Amman, Jordan.
- Royal Society for the Conservation of Nature, Amman, Jordan.
- UNEP - P.O. Box 30552, Nairobi - Kenya.
- University of Jordan, Yarmouk University.

A-4.2 Acknowledgements

For advice and assistance rendered outside Jordan, we extend thanks to:

- Dr. Danny Elder, Coordinator, Marine and Coastal Programme, IUCN–The World Conservation Union.
- Ms. Doreen Smith, U.S. Divers Co., Inc.

6 • Energy and Mineral Resources¹⁸

Environmental aspects of the energy and mining sector are discussed in this chapter. The discussion includes (i) fossil fuels, which include oil, natural gas, oil shale and tar sands; and (ii) renewable sources of energy, which include geothermal energy, solar energy, and wind energy. Phosphate and other mining activities make a large contribution to Jordan's economy and the environmental effects of these operations are detailed as well.

1 ENVIRONMENTAL ISSUES AND FOSSIL FUELS

1.1 Oil

There is much published information on conventional air pollution and waste water effluent problems pertaining to the different operations in the petroleum and petrochemical industries. Given the present structure of Jordan's economy, the main pollutants of concern are: a) air pollution, b) waste-water effluent problems, c) disposal of oily wastes from refineries and spills, and d) disposal of hazardous chemical wastes.

Refinery pollution. The main activity of Jordan Petroleum Refinery Company (JOPETROL) is refining crude oil, and storing, importing and distributing petroleum products, mainly in order to meet local market demand. JOPETROL employs heavy equipment and machinery, consumes chemicals and burns fuel in process units, heaters and boilers as a source of energy.

As with other heavy industries, some pollutants in gas, liquid and solid forms are produced, as a result of different processing activities, Noise from heavy equipment and rotating machinery is another pollution problem.

Pollution abatement in the JOPETROL refinery. Pollution is being abated within the refinery for:

- Air pollution.
- Waste-water pollution.
- Spent soda.
- Spent lube oil.
- Solid wastes.
- Noise.
- Tetra Ethyl Lead.

Thermal power plants. *Hussein Thermal Power Station (HTPS):* the sources of air pollution are SO_x, H₂S, CO, CO₂, NO_x, and particulate emission. In addition, the possible groundwater pollutants are sulphates and chlorides from acids, and sodium from caustic soda used for regeneration. *Aqaba Thermal Power Station:* as in the Zarqa area, the environmental problems at the Aqaba Thermal Power Station are mainly air and water pollution.

1.2 Natural Gas

Natural gas is produced in the Risha area, northeast Jordan. Three wells have been exploited. The quality of the discovered gas is very good, because the heating value is high and there is low sulphur content. The gas has been utilized recently for the production of electricity (60 mw output) where two gas turbines are employed. A collection and treatment plant to extract the water content from the gas is used. The environmental impacts are: (i)

¹⁸Information in this chapter was prepared by the Energy Committee, under the Chairmanship of Eng. Asem Ghousheh, Secretary General, Ministry of Energy & Mineral Resources.

flue gas emissions CO, CO₂, NO_x, and (ii) CO content, which causes corrosion when it reacts with water.

However, relative to other energy sources, natural gas is one of the cleanest fossil fuels when used for domestic and industrial purposes.

1.3 Oil Shale and Tar Sands

The production of syncrude and the generation of electricity based on the thermal decomposition and direct combustion of oil shale are associated with considerable environmental problems.

If Jordanian oil shale is utilized in future, it is possible to reach a compromise between such utilization and the preservation of the environment. It is obvious that during mining, processing and direct combustion of oil shales, the following major environmental effects can be expected:

- Air and water pollution.
- Solid and liquid wastes.
- Potentially hazardous health effects.
- Alteration of land.

A possible production and use of tar sand in the future might lead to negative influences on the environment due to SO and nitrogen-bearing emissions during combustion. The residual (tailings) and ashes might cause groundwater contamination if not disposed of in safe places.

2 RENEWABLE SOURCES OF ENERGY

The general realization of the finite nature of fossil fuel resources, their negative impact on the environment and cost of importation, have caused a re-examination of the possibility of using those energy resources which are of a non-depletable nature and, therefore, are considered renewable. Such sources of energy are potentially significant to the developed and the developing countries.

Renewable sources of energy vary widely in their impact on the environment.

2.1 Geothermal Energy

A programme of research on a regional scale into the geothermal resources of Jordan was implemented by the Natural Resources Authority in 1989. The project is designed to extend previous work, which was concentrated around the Zarqa Ma'in and Zara hot springs, in order to assess the geothermal resources of the whole country. Staff of the British Geological Survey are acting as advisors to the project, which involves co-operation among several scientific disciplines.

The project is still in its early stages, during which data are collected prior to assessment. However, it is already apparent that significant low temperature resources (less than 100° C) exist in two main areas.

Eastern margin of the Rift. First, many thermal springs and boreholes exist along the eastern margin of the Dead Sea Rift. Known manifestations occur from the Yarmouk River area in the north, to the Afra springs in Wadi Hasa south of the Dead Sea. The Zarqa Ma'in thermal springs form the best-known resource and produce a total of around 60 thermal MW/m². Some of these springs have been tapped for the spa and hotel complex at Zarqa Ma'in. Two other geothermal sites which could be considered for industrial, agricultural and tourist development are the Lisan area and the Afra springs.

In Ibn Hammad, near Lisan, a borehole drilled to around 800 metres has encountered water at a temperature of 50° C. The well is artesian and flows without pumping at an

estimated rate of $400\text{m}^3/\text{hr}$. This implies a potential heat output of around $13\text{ MW}/\text{m}^2$. If this capacity were proven by a production test, the absence of pumping costs and the ease of access to the site (via the Karak–Wadi Araba road) would suggest that this would provide an easily exploitable resource for an industrial or agricultural process requiring heat.

The Afra springs further south have a substantial flow of water at temperatures up to 45°C , and as with the Ibn Hammad borehole, are easily accessible by road. The use of such a resource for a project such as fish farming should be considered.

Plateau east of Madaba. The second area of proven geothermal resource is on the plateau south of Amman, in a region east of Madaba. Here more than 20 private wells used for irrigation discharge thermal water at temperature of $30\text{--}40^\circ\text{C}$. The fact that these wells have proven yields and produce water at elevated temperatures in an agricultural area where winter temperature can be low makes feasible their exploitation for greenhouse heating.

Since geothermal energy must be utilized or converted in the immediate vicinity of the resource to prevent excessive heat loss, the entire fuel cycle, from extraction to transmission, is located at one site. This offers environmental advantages in terms of land area requirements and use, and in terms of effluent management. In addition, geothermal power stations do not generally need an external source of water for cooling, since the condensed steam is recycled for that purpose. On the other hand, geothermal energy has a number of negative environmental effects that are site specific, varying according to the geochemical characteristics of the geothermal reservoir. Hydrogen sulphide is the main airborne effluent of real concern in geothermal fields. The main problem encountered is its objectionable smell, but it tends to concentrate around geothermal plants, and so far no health problems have been encountered in communities living near such plants.

2.2 Solar Energy

Solar energy in Jordan is mainly used for water heating for domestic purposes. Solar panels are being used in about 12% of all houses (Household Survey, 1986). Work is being carried out on improving the efficiency of the panels and reducing costs to improve their economic viability. The following are the main activities undertaken in this field by the RSS or the Ministry of Energy and Mineral Resources:

- Seawater desalinization using the heat-pipe principle.
- The solar house.
- Flat plate collectors.
- An agreement with a Euro-American consortium was concluded to study the economic feasibility of constructing a $30\text{ MW}/\text{m}^2$ electricity generation plant, as Jordan was selected as a test site for this purpose.

Major uses. At present, the major uses of solar energy are for water heating for domestic and industrial purposes, solar drying for products, space heating and cooling, refrigeration, water distillation and desalinization, cooking and water pumping. Thermal electricity conversion and photo-voltaic conversion are other applications of solar energy that are receiving increased attention in many developing and industrialized countries. Solar energy devices have a number of environmental impacts. Decentralized small units reduce the demand for fossil fuel, leading to conservation of such non-renewable sources of energy and to a reduction in amount of pollutants emitted by burning such fuels. The utilization of solar energy in developing countries, especially in rural and remote areas, can lead to substantial improvement in the quality of life.

2.3 Wind Energy

RSS interest in wind energy applications began in 1979. It purchased and installed a mechanical wind pump for the Aqaba Region Authority to pump groundwater for its housing complex from about 30 metres' depth. Later, a completely mechanical windmill for water pumping was erected in Amman. This windmill has been in operation for five years

and was moved three years ago to Mudawwara station in southeast Jordan. The research conducted by the RSS showed that Jordan has a moderate wind energy potential.

Ibrahimiye Pilot Project. In 1988 electricity was produced from wind at the Ibrahimiye Pilot Project. This pilot plant consists of four wind turbines, each with a power of 80 kw, connected to the national grid. Technical and economic evaluation of wind utilization for electricity generation in Jordan will be continued.

During 1988 about 0.7 gwh were generated per year, and the preliminary results indicate that the cost of the operation is high compared to conventional generation methods. A study is being continued to investigate the possibility of manufacturing some parts of wind turbines locally (e.g., blades) to reduce capital cost. A wind atlas is being prepared for Jordan to aid in site selection of wind plants.

Different types of wind energy converters have been produced, ranging from a few watts to 100 kw, for battery charging, water pumping and rural electrification systems. Machines for generating electric power in the range of 100 kw to 5 mw are also being developed. These machines are normally connected to the national electricity grid.

Environmental concerns about wind energy involve such factors as the risk of accidents, noise, interference with telecommunications, visual impact, and the possibility of micro-climatic alteration.

2.4 Biomass

Biomass is of little significance in Jordan and has low potential given the severe constraints on vegetative growth imposed by an arid climate. Today, direct combustion of biomass provides some energy for cooking and heating in rural households. However, the uncontrolled and indiscriminate collection of firewood leads to soil erosion and degradation and enhances the desertification process. Aggressive and ambitious reforestation today could provide additional fuel for the next generation of Jordanians.

It can be concluded that if research and development work is intensified, renewable energy sources may in future contribute significantly to the energy requirements of the Jordanian economy and to reducing the ecological problems associated with other oil-based energy sources.

3 ENVIRONMENTAL ISSUES AND THE MINING OF METALLIC AND NON-METALLIC MINERALS

The exploitation of minerals in Jordan has a long history, from the use of flints in the Stone Age to the early working of copper in Wadi Araba in the Bronze Age. In more recent times and during the last three decades, the mining sector has developed rapidly to respond to the increasing needs of national industries, and many bases of mineral-related industrial undertakings have been set up. However, the development of some mines and quarries has led to certain problems, because the effects of many activities on the natural environment have been neglected in the course of mineral extraction.

3.1 General Aspects of Mining and the Environment

Before turning to the most important common and specific impacts of mining on the environment in Jordan, it is useful to discuss a number of general principles relating to this topic:

a) The development of mineral resources and a healthy environment is essential to the people of Jordan, now and in the future. The best means of ensuring that both are adequately taken into account is to adopt an integrated approach to natural resources and environmental protection. The aim should be to fit a mine and its waste products into the natural environment in such a way as to minimize unwanted effects.

- b) Modern technology permits mining on a vast scale with a potential for major disturbance of a whole region, e.g., opencast phosphate mining.
- c) A major consideration in the development of mineral resources is the restriction it imposes on future land use, for such purposes as grazing, agriculture, forestry (in areas of higher precipitation), wildlife, recreation, and rural and urban settlement.
- d) World-wide experience of land rehabilitation has developed a high level of expertise in this field. The aim should be to leave land at least in as productive and useful a condition as before the mining took place. Many examples exist in Europe and North America, where mining has improved the subsequent usefulness of land for grazing or other uses. But in the case of Jordan, rehabilitation will prove more difficult at mine sites located in desert areas.

The impact of mining and quarrying on the environment can be summarized as follows:

- Disturbance of the plant cover.
- Removal of topsoil.
- Air pollution.
- Environmental health hazards.
- Pollution of surface water.
- Deterioration and contamination of groundwater.
- Infiltration into coastal and marine waters.
- Radioactive pollution.
- Creation of many hazards for construction and building.

In addition to the above-mentioned common impacts of mining activities on the environment, it is useful to mention the specific impacts of each of the existing mining activities in Jordan separately.

3.2 Phosphate

Sources of pollution. The phosphate mining industry, in addition to the problems of quarries, exerts the greatest and most important influence of any industrial enterprise on the Jordanian environment. Intensive development of phosphate and phosphate products results in serious practical problems. The main sources of pollution in phosphate mining are:

- The mining complex.
- Beneficiation plants.
- Ancillary facilities.
- Transport and Aqaba port facilities.
- The township.

Environmental effects. The exploitation of phosphates has several effects on the environment, which can be summarized as follows:

- Dust emissions.
- Environmental health hazards from air-borne dust.
- Noise and vibration due to blasting.
- Disposal of overburdens and interwaste.
- Solid rejects and reagents from flotation.
- Slime disposal.
- Effluents from ancillary facilities and the township.
- Transport, loading and unloading of trucks.

3.3 Potash

Emissions generated by the potash industry are a result of six functions within the overall potash recovery process. These are:

- Combustion of fuel oil in the boilers, driers, trucks, buses, harvesters and all other equipment directly related to the project.

- NaCl precipitation in the tailings pond.
- Drying of the final product (KCL).
- Fuel storage.
- Sanitary waste disposal.
- Transportation.

3.4 Other Mining Operations

- Cement raw material: particulate matter is the primary emission in the manufacture of cement. It is emitted from the crushing operation, storage silos, rotary driers and rotary kilns.
- Glass industry: emissions from glassmelting operations consist primarily of particulates, and fluorides if fluoride-containing fluxes are used in the process.
- Ceramic industry: emissions consist primarily of particulates, but some fluorides and acid gases are also emitted in the drying process.
- Rock wool industry: the major source of emissions is the cupola or furnace stack. Its discharge consists primarily of condensed fumes that have volatilized from the molten charge, and gases such as sulphur oxides and fluorides. Minor sources of particulate emissions include the blow chamber, curing oven and cooler.

--- 4 EVALUATION OF NON-RENEWABLE ENERGY RESOURCES ---

4.1 Petroleum Exploration

Petroleum exploration in Jordan can be divided into three distinct phases:

Phase 1: 1947 to 1975. Six concessionaires conducted oil exploration which involved geological and geophysical surveys and the drilling of 14 exploratory wells. Although some oil and gas shows were observed, the companies failed to find oil in economically significant quantities, and they withdrew.

Phase 11: 1976 to 1985. Although the NRA was established in 1965, it was not until 1976, after the inconclusive results of the foreign oil companies, that the government embarked on an exploration programme. As a result of its geological and geophysical studies, 18 exploratory wells were drilled. Oil was discovered in the Hamza field in the Azraq area. Production commenced in 1984 from three wells by natural flow. The Hamza discovery, the wealth of geological and geophysical data accumulated up to the mid-eighties, the open-door policy adopted and free access to all available data, amongst other factors, convinced several international companies to conduct petroleum exploration in Jordan under either production-sharing agreements or assistance programmes.

Phase 111: 1986 to the present. During this phase the government strategy has consisted of:

- Promoting private investment through an open-door policy to attract international companies.
- Exploring for and developing hydrocarbon resources by the NRA in open areas. As a result of this new strategy, an additional 34 wells were drilled, producing a cumulative total of 66 wells to date.

During 1986-87, three production-sharing agreements were signed with three groups of companies. All the companies have completed their geological studies and seismic surveys, and drilled a total of four dry wells. They withdrew after fulfilling their obligations.

Over the past two and a half years, the NRA has succeeded in concluding assistance or aid programmes with three countries—Canada, Austria and Japan—to assist in local efforts to explore and promote the open areas for international oil companies.

The activities of the third phase resulted in the 1987 discovery of sulphur-free natural gas in the Risha area near the Iraqi border. Average daily production is 20 million cubic feet

from two wells, which went on-stream in March, 1989. The drilling of two other wells was completed recently, significantly adding to the total reserve.

4.2 Oil and Natural Gas Production

Oil and natural gas are the only energy resources which are being utilized. The reserves in the Hamza oil field at Azraq are estimated to be around 90 million barrels of oil in place, of which around 10 million barrels are thought to be recoverable.

Oil production and imports. Locally produced oil, even though in minor quantities, is processed at the Jordan Petroleum Refinery. Crude oil is imported to cover the local demands of different finished products. Some finished products are also imported (LPG, diesel oil, fuel oil, lube oil base stocks). Imported quantities of crude oil since 1984 and the quantities produced from the Azraq field as well as imported quantities of different finished products are detailed in Tables 2 and 3, Annex 1.

Gas from Risha. The Risha gas reserves are estimated to be 74 billion standard cubic feet (SCF) (Risha Well No 3: 26 billion SCF, No 6: 33 billion, No 8: 15 billion). The mode of gas occurrences in the Risha area is not fully understood. Because of the transmissibility, thickness of reservoir rock, facies changes and other heterogeneities of the reservoir rock, it would be premature to estimate realistic figures for the potential gas reserves. However, the possible reserve could be up to 400 billion SCF.

The gas from the Risha field is utilized to generate electricity in the Risha Power Station (60 mw), where two gas turbines are employed. Development of the customer base for electric power is shown in Table 1, Annex 1. A collection and treatment plant to extract the water content from the gas is used (at 23 million NCF/day).

Energy demand. The current trend in local demand for energy shows a slight increase, mainly due to the economic situation and slow development growth. The future trend in energy demands depends totally on population growth, the economic situation and development plans, willingness to adopt and develop energy conservation plans, and utilization of renewable energy resources, among other factors. The expected annual growth in demand is 4 to 6%.

The results of hydrocarbon exploration carried out so far justify further investigation. A long-term development programme is warranted. The programme should include a regional country-wide development programme and a development programme for prospective hydrocarbon areas.

The programme is well-defined; reference can be made to the documents of the NRA and, in particular, the published book about *Natural Resources in Jordan* (1988).

4.3 Oil Shale

Jordan possesses a significantly large energy resource in its vast reserve of oil shale. About 43 billion tons of oil shale have been discovered in central Jordan. Data on site locations, quantity and oil content are listed in Table 4, Annex 1.

Besides the five deposits mentioned in Table 4, ten more near-surface occurrences are known, with a large potential for opencast mining. In addition, seven occurrences with an equally large or even greater potential for underground mining were found, but not investigated. The most important one is the Yarmouk occurrence, which has enormous thickness (approximately 300 m). Many of these deposits occur in geological situations facilitating their development into exploitable deposits.

Two oil shale deposits (Lajjun and Sultani) have been investigated sufficiently for exploitation. These deposits have been chosen for technical and economic feasibility studies, Lajjun for retorting and Sultani for direct combustion for electrical power generation. Studies are still in progress.

4.4 Tar Sand

The term tar sand is used here for sandstone and other permeable rocks which are impregnated by residual oil. It originated from hydrocarbons which migrated from great depth to the present sub-surface or outcrop occurrence where the hydrocarbons lost their light components and degraded to heavy viscous oil or tar.

A total of about 35 million tons of tar sand has been discovered recently in the Wadi Isal area, east of the Lisan Peninsula, with an oil percentage of about 10% by weight. The oil has very high viscosity, low gravity and high sulphur content (2% to 6%). Other occurrences were tested, which crop out at a number of places along a major fault between Isal and Kharaza. If tar sand is available in sufficient quantities and the mining cost is low, this tar sand would be suitable for direct combustion for generating electricity, or for solvent or thermal extraction of the hydrocarbons. The necessary technology exists for using the sulphur as a by-product.

The high cost of the fuel and the continuous growth of energy consumption warrant further exploration and investigation to cover at least a part of this consumption by using national resources.

4.5 Other Non-Renewable Resources

Residual oil was formed by sub-surface flushing and degradation of oil accumulations in the Hamza-Wadi Rajil area, Azraq. Reserves of about 213 million m³ of residual oil and asphalt are thought to exist from a sub-surface area of more than 220 sq km. This amount is still questionable.

Asphalt. Asphalt is occasionally found along the shores or floating in the Dead Sea. It is of no commercial interest.

Coal. Coal fragments are found in several locations on the east side of the Jordan River (King Talal Dam-Arda highway) and recently in the Baq'a area. No deposit of commercial value is known.

Uranium. The phosphate deposits of Jordan contain uranium, ranging in content from 65 ppm to 170 ppmu. The phosphorite beds show very wide lateral and depth variation in uranium content. Generally speaking, the uranium content decreases southwards from Russeifa to Hasa and Shadiya.

Uranium and thorium in sandstone. Research and exploration for uranium and thorium in sandstone in the area between Disi and Mudawwara is still going on.

5 EVALUATION OF RENEWABLE SOURCES OF ENERGY

5.1 Geothermal Energy

Twenty-eight thermal springs have been recorded in the highland area east of the Jordan Valley. These represent a considerable low-enthalpy geothermal resource. Elsewhere in Jordan anomalous temperatures have been recorded from some deep wells; and thermal waters, some of which are artesian, have been encountered in 40 water wells drilled in central and eastern Jordan.

5.2 Solar Energy and Wind Energy

Jordan possesses a good solar resource and an acceptable wind energy resource. Thus, it is important that research and development activities concentrate on these resources. Among the numerous organizational measures realized in the last Five-Year Plan was the establishment of a Ministry for Energy and Natural Resources, which deals mainly with energy planning and policy actions. The ministry gave renewable energy and conservation

of energy high priority, and a separate department (Renewable Energy Dept.) was established to deal with this matter.

Applied R&D in this field in Jordan concentrated on the following: solar water heaters for domestic and industrial applications, space heating, water pumping utilization, photovoltaic and wind energy converters, delivery of electrical power for a remote village utilizing a hybrid system of wind energy and photovoltaic systems, and supplying power to radio communication systems and other electrical loads required in isolated villages, using photovoltaic generators.

Current policy on alternative energy. There is a policy to promote the use of alternative energy, such as biogas, solar and wind energy, and encouraging private-sector participation in their development.

The following measures are recommended:

a) Assistance, facilities and incentives should be provided to consumers, according to need, and to institutions involved in the production and distribution of alternative energy technologies.

b) Along with the collection and analysis of necessary statistics for developing solar energy and wind energy, measures should be taken to spread existing technology.

c) Encourage implementation of energy conservation projects, including combined heat and power production, waste heat recovery systems, high-efficiency cycles and developed technologies for efficient utilization of energy in an environmentally acceptable manner.

6 NON-METALLIC MINERALS AND INDUSTRIAL ROCKS

Potential exists for the exploitation of minerals in Jordan, in particular non-metallic minerals and industrial rocks. It is very clear that the potential of the mineral sector in Jordan has not been fully established nor have known deposits been fully exploited. Non-metallic minerals contribute considerably more to the value of mineral production in Jordan than do metallic minerals.

In 1989, the production of minerals in Jordan was valued at approximately \$650 million, representing primarily phosphate, potash, cement raw material, limestone, glass sand, clay, gypsum and limestone.

Opportunities exist to increase exploitation of non-metallic minerals. Such exploitation will not only contribute to Jordan's economy, but will also produce materials—especially structural minerals such as sand and gravel—which are crucial to the engineering works of Jordanian cities, transportation systems and industrial facilities. The availability, quality and quantity of non-metallic minerals can affect growth in other sectors of the economy. Other development activities, however, can limit the options for wise use of Jordan's mineral resources.

The following discussion of the non-metallic mineral resources of Jordan evaluates each mineral as to whether prospecting and exploration could eventually lead to economic exploitation. Sites deemed developable, will have to be assessed for their environmental consequences if they are slated for production.

6.1 Phosphate

Phosphate deposits are exposed or located near the surface along a north-south striking belt, about 200 km long and 10-25 km wide. The belt extends from Russeifa in the north to Hasa in the south. Two other major occurrences are the Shadiya deposit (50 km southeast of Ma'an) and one in Irbid Governorate in north Jordan.

In Russeifa, four phosphate beds have been mined since 1959 with an average content of 70.3% tri-calcium phosphate (TCP). The proven reserves are about 70 million tons of high-

grade phosphate. Because of the unfavourable mining and transport conditions, opencast and underground mining have been suspended.

Mines at Wadi Abyad, Hasa and Shadiya. The two opencast mines at Wadi Abyad and Hasa produce ore of TCP grades between 65% to 70% from the upper horizon, and 73% from the lower horizon. The proven reserves are estimated to be 183 million tons. The geological reserves of the area between Hasa and Qatrana are in the order of 1 billion tons. Production at Hasa started in 1962, and at Abyad in 1979.

The Shadiya deposit covers an area of about 125 sq. km. Several deposits have been discovered, but the detailed study was concentrated in one area. Two western and eastern ore bodies were identified. The total proven reserves are estimated to be in the order of 958 million tons. Production started in 1988.

6.2 Potash

Potash (soluble potassium salt minerals) occurs in huge quantities dissolved in the Dead Sea water and as stratiform layers within the salt dome of the Lisan Peninsula.

The average salt content of the Dead Sea is about 31.5%. Approximately 45 billion tons of salts are dissolved in the Dead Sea water. These salts are very important for the economic development of Jordan. In extensive pans, Dead Sea water is evaporated for increasing the salt concentration in the brine, and for the selective precipitation of potash salts. At present, the only salt extracted on a large scale is potash, with sodium chloride or salt as a by-product. Initial production at the potash plant at the southeast end of the Dead Sea was about 1.2 million tons of potash annually, which increased to about 1.4 million in 1989.

6.3 Gypsum

Gypsum is used mainly in the cement and building industries. The most important deposit occurs approximately 35 km northwest of Amman near the Zarqa River at Wadi Huna. Approximately 60,000 tons of gypsum were quarried in 1989 for the manufacture of cement. The proven reserves are estimated to be 1.1 million tons; the possible reserves are 7.3 million. Other occurrences are at:

- Jabal Mulayh and Wadi Hasa, 14 km north-northwest of Tafila.
- Area between Wadi Mujib and Tafila (approx. 1 million tons).
- Dhira area, east of Lisan Peninsula (not calculated).

The gypsum on Jebal Mulayh is being produced for the cement plant in Rashadiyya. The total reserves were estimated to be approximately 1.5 million tons. The potential for discovery and development of further gypsum deposits seems to be promising in the above-mentioned areas.

6.4 Clay

Clay is not a mineral but an aggregate of minerals and colloidal substances. The term is applied to earthy substances consisting chiefly of hydrous aluminium silicates.

Occurrences. (i) Ghor Kibid. Main: kaolinite. Accessory minerals: quartz, illite, muscovite. Reserves: 487,000 tons. Three layers (A: 1.8m) (B: 1.8m) (C: 0.8m). (ii) Mahis Clay: constituents as Ghor Kibid. Reserves: 1.9 million tons, three layers. (iii) Batn Ghoul: exploration and evaluation of the deposit are still in progress. (iv) Azraq: exploration and evaluation of the deposit are still in progress.

The government has launched a policy of diversifying the mining sector to reduce development pressure. A number of commodities have been selected for promotion as exports, such as clay, tripoli, glass sand, bentonite, and tuff. Thus, the issues in this sector concern both the strategy for diversification and how to take full advantage of the opportunities available from these raw materials to minimize import costs.

6.5 Limestone and Glass Sand

Limestone occurrences. Limestone of potential use for various purposes have been located in the areas listed below. The exploitable reserves are practically unlimited. Ma'an: unlimited reserves, Al Husseinieh: in many areas, Mafraq, Ajloun and Irbid.

Glass Sand. The term glass sand is applied to quartz sands that conform to the following specifications: ($\text{SiO}_2 > 99\%$, $\text{FeO} < 0.05\%$). Heavy minerals below 0.1%. Range of grain size from 0.1 mm to 1 mm. **Occurrences.** Ras Naqab: 5 million tons proven; one billion tons indicated. Qa' Disi: huge reserves. Petra area: huge reserves. Aqaba: 10 million tons proven. The glass sand occurrences have excellent potential for further development. If it is possible to produce top-quality glass sand by the application of further upgrading techniques, export to nearby countries might become a commercially viable endeavour as well.

6.6 Feldspars

Feldspars are the most abundant igneous rock-forming mineral. Potassium feldspar (orthoclase) has the main commercial value. Huge reserves are in the "Aqaba complex" of igneous rocks. **Occurrences.** (i) 3 km east of Aqaba; crushed granite. (ii) 18 km northeast of Aqaba, along the Aqaba-Ma'an highway. (iii) Wadi Hawd Sufun, 7 km south of Aqaba. (iv) Wadi Mahlaba, 51 km northeast of Aqaba. The feldspar deposits located east of Aqaba started to be exploited recently for the glass and ceramics industries. However, future exploration should be focused on locating feldspar raw material whose mining and beneficiation are less costly.

6.7 Basalt

Occurrences. 50 km northeast of Amman, northeast Jordan. Basalt, a volcanic rock, is a basic material for the manufacture of rock wool. The basalt flows of northeast Jordan cover more than 1,000 sq. km. The basalt is exploited at present (around 10 t/a, capacity 5,500 t/a) by a rock-wool producing firm. Reserves of basalt at the location now under exploitation are approximately 201 million tons.

6.8 Rock Salt

Rock salt (NaCl) is produced only in small quantities in the area of the Azraq depression by evaporation using saline water from a shallow aquifer. It is also produced as a by-product in the potash industry, but it is not used and all the production is dumped near the plant.

A huge amount of rock salt (more than 100 billion tons) is located in the sub-surface of the Lisan Peninsula. Its exploitation would be a technological-economic question rather than one of the definition of further resources.

6.9 Others

Tuff. Tuff is a product of volcanic eruption. It is used in cement production; 5%- 20% by weight of tuff is added to the raw material. Tuff occurs in several areas: Tell Hassan, Tell Rimah and Tell Maqais, Tell Queis and Jabal Aritein. The reserves are unlimited.

Zeolites. Occurrences: Associated with tuff in Jabal Aritein, Tell Rimah, Tell Hassan. The resources are huge but have not been determined yet.

Dolomite. Occurrences: Ras Naqab, Wadi Musa, Wadi Mujib, Zarqa Ma'in, Wadi Salayhi, Shadiya and Ain Ghazal. Reserves: huge. Under evaluation at present.

Dimension Stones. a) Marble. Between Dab'a and Qatrana. Reserves > 1.7 million tons. b) Travertine. South of Deir Alla. Reserves 25 million tons. c) Alabaster. Hasa. Reserves not determined. d) Saramuj Conglomerate (not exploited). Ghor Numeira. Reserves not determined. e) Granite. Aqaba.

Aggregates (sand, gravel and crushed stone). Huge amounts of sand, gravel and crushed stone are used in the building industry and for construction of roads, for the road base, in asphalt and concrete, and in dams, railroad, and airports. Sand is quarried mainly in the Balqa and Tafila governorates, but is also produced from other occurrences all over the highland area. The annual relative share of aggregates products to total revenue from minerals in the local market is 19%.

Bentonite. Bentonite is the commercial name for a clay with a montmorillonite content of at least 70% and with technical properties including the ability to swell. It is found in the Azraq Basin. The thickness and quality of the bentonite differs from place to place. It is generally of low grade because of the presence of varying amounts of gypsum, silt, and other impurities. A new exploration programme started in 1990. Reserves: the reserves and quality have not been defined yet.

Sulphur. Occurrences: sulphur is found in Jordan in the following forms:

- As native sulphur in the Dead Sea area at Lisan.
- In oil shale, oil sand, heavy oil and asphalt at Hamza-Wadi Rajil.
- In gypsum and anhydrite.

Tripoli. Tripoli is a porous, soft, earthy substance composed mainly of pure, cryptocrystalline to microcrystalline silicon dioxide (SiO₂). Uses: tripoli is used for the manufacture of paints, in the ceramic industry, as a filling agent, and as a soft abrasive. Occurrences: mainly in Karak area, Aynun, Shahabiyeh, Rakin, Wadi Falqa. Reserves: 2.4 million tons in the four areas. The total thickness of the tripoli beds ranges between 8 m and 18 m.

Barite. Uses: (world-wide): approximately 85% for drilling mud, 10% for reduction of barium chemicals, 5% for other purposes. Occurrences: Northeast Jordan: 46 km northwest of Ruweished (Wadi Mingar), Zakimat Hasa: 52 km southeast of Bayir, Aqaba: 3 km north of Aqaba, Dahikiya: southeast of Azraq.

Anhydrite. Anhydrite (CaSO₄) is the water-free equivalent of gypsum CaSO₄ 2H₂O. Occurrences: anhydrite is mentioned in a number of oil exploration well log, Lisan area, Wadi Huna (associated with gypsum.)

Apatite. The mineral apatite is the main source of phosphorous in nature. Occurrences: 5 km west-northwest of Sweileh. Reserves: 300,000 tons proved; 650,000 tons possible; 900,000 tons assumed. Apatite (tri-calcium phosphate) forms 71.8% of the deposit.

Agate. Occurrences: between Ras Naqab and Siwaqa; it is presently of no commercial value.

Amber. Occurrences: Amman-Jerash road, Zarqa River (north side). Not suitable as a semiprecious stone due to its brittle nature.

Pumice. Occurrences: southeast of Azraq, 5 km north of Goblin Hazim. The reserves have not been determined. The potential to define pumice reserves of commercial interest is considered to be good.

Other common minerals or metals which have not been studied include pyrite, mineral pigments, olivine, mica, rutile, rubidium, magnesium, iodine, bromine, quartz, and semiprecious stones.

7 TOWARDS ENVIRONMENTALLY SOUND MINING AND ENERGY PRODUCTION

7.1 Improper Practices

The following are a number of improper practices which affect mineral resources and the environment:

a) Development plans: one of the primary objectives of Jordanian development plans is to increase the value of Jordan's exports and to achieve import substitution in areas where the country currently imports products made from minerals that can be produced

domestically. The other objective is to sustain economic growth, which means that mineral production must grow continuously.

b) **Increasing industrialization:** Jordanian industry has grown significantly over the last decade, and there are ambitious plans to build more factories. Such efforts are intended to create an industrial base that will contribute to the growth and prosperity of Jordan. Nevertheless, despite the advantages and benefits of these industries, they will add to environmental pollution, which affects all aspects of life. In addition, these industries need considerable amounts of energy and raw material, which are not properly utilized in most cases. Therefore, one of the key challenges is to change energy-wasting behaviour to energy-conserving behaviour.

c) **Lack of proper mining methods:** mineral wealth contributes significantly to the economic development of Jordan, but unsystematic and unplanned mining in some cases has generated many environmental hazards. The impacts on the surrounding environment by mining activities through various processes of exploration, mining, drilling, blasting, loading, unloading, crushing, transportation and beneficiation should be studied, and pollution control measures should be adopted.

d) **Absence of a well-defined monitoring programme:** mining can arguably claim to be the oldest industry in the world, but it is only now, with the aid of recent technological developments, that accurate and comprehensive monitoring of a mine can be carried out.

Phosphate mine wastes. The fundamental problems of mining in Jordan are considerable and persistent. Of most significance is the enormous volume of waste generated by the extraction process of phosphate deposits. There is no real programme to monitor the exploitation phase and give advice on restoration policy or to enforce the regulations concerning the mining law and improve the visual impact of the mine waste.

e) Other problems are lack of proper planning; the absence of a comprehensive Environmental Impact Assessment procedure; and poor or non-existent co-ordination among concerned government departments and also among the private sector.

f) Competition among various possible land uses, such as mining and grazing, or mining and agriculture.

The competing demands for various land uses should be managed in the interest of achieving sustainable development within the renewable resource sector. Thus, the development of energy and mineral resources should also allow other uses to be sustainable over the long term, all of them making contributions to Jordan's economy. Integrated resource-planning is called for to resolve conflicts; and to establish a policy position prior to development, where mining or energy development encroach upon lands used for agriculture, grazing, habitat for wildlife or settlements.

Water scarcity and mining. Water is commonly used in the sorting and enrichment of minerals together with ore dressing. These activities are commonly done close to mines to reduce transportation costs. The deposits of waste rock and slurry are a standard feature of mining areas.

In Jordan, most mineral deposits occur in regions where water resources are limited. The effectiveness of investing in water supply schemes can be raised by making them multi-objective systems which can provide water for both settlements and agriculture, besides meeting the water demand of the industry itself.

A special example of a multi-purpose structure is the construction of dams for reservoirs using the slurry from mines. (The disposal of such waters is always a big problem in mining operations). Another example is recycling water used in the plants. Because of limited supplies of fresh water, it is desirable—and sometimes imperative—to recycle any water that may be recovered from various industrial operations, rather than disposing of it as production waste.

8 RECOMMENDED ENERGY STRATEGIES BY SECTOR

The concept of sustainable development does not apply directly to oil and gas resources because they are neither renewable nor sustainable over the long term. This means that we should not exploit the resources (if they are available) at a rate which exceeds our ability to develop an alternative source or a substitute product. Managing oil and gas resources (domestic and imported) is not a simple matter, nor can it be done in isolation from the economic, political, social, and environmental events occurring in Jordan and the Middle East.

In Jordan, there are several alternative energy resources which could be utilized in the future; these are oil shale, tar sand, heavy oil, geothermal energy and renewable energy sources. How Jordan wishes to develop its energy resources is a matter that deserves very serious discussion in light of the enormous uncertainties involved in attempting to plan for the future. Global technological developments can have a major impact on the utilization of alternative energy sources as can changes in public policy.

There are a number of sector strategies which can help the country save energy. These are drawn from North American experience, but still have direct relevance to the Jordanian situation (see sections 8.2-8.5).

8.1 General Energy Strategy

Jordanians are faced with some tough decisions about their energy future. Therefore, the future strategy to manage the energy sector should consider the following actions:

- Improve exploration and continue the open-door policy. More sophisticated methods of exploration should be used. Research for better understanding of the deposits is essential for the development of more efficient means of discovery, extraction and processing.
- Switch from high-emission to low-emission fuels, such as natural gas, the cleanest fossil fuel. However, before such a substitution process is launched on a large scale, the economics and security of supply implications need to be analyzed very carefully.
- Use and manage our non-renewable resources (oil, natural gas, oil shale, tar sands) in the interest of developing a long-term sustainable economy for Jordan.
- Increase support for R&D.
- Promote energy conservation and energy lifestyle changes. Energy conservation should be a central part of the strategy to meet energy requirements. Economic growth does not have to depend on increased consumption of energy. In Jordan, the need to meet long-term energy requirements of future economic development in the face of limited and uncertain supplies makes energy efficiency and conservation an essential element of development efforts. The strategy must take into account the specific fuel mix and technologies being employed in the following economic sectors: industry; (ii) agriculture; (iii) transportation; and (iv) housing and commercial building.

8.2 Strategy for the Industrial Sector

Pollution generated from industries and power plants is associated with gaseous emissions and polluted waste water and materials. Energy conservation directly reduces pollution emissions from various processing units. Education, awareness-raising and technical training should continue through seminars, training courses, and pamphlets.

The following measures and projects could be adopted with incentive policies for implementation (regulations, economic incentives and encouragement, investment):

- Combustion-efficiency improvement in steam boilers and thermal furnaces and equipment. Monitoring and control of flue gas emissions should be improved as should

instrumentation, laboratory measurements and process control. Also improve fuel-system monitoring and control.

- Improve the steam and condensate distribution system piping network and thermal insulation.

- Improve insulation for thermal units and systems: steam, heat exchangers, reactors, distillation columns' dryers, evaporators.

- Waste heat recovery systems: waste heat boilers, preheaters, recuperators, heat wheels and pipes. Economizers, regenerators, heat pumps.

- Fuel diversification and renewable energy use: e.g. replace heavy oil with diesel (less cost). Replace gas with oil (less pollution).

- Combined heat and power production (co-generation).

- Easily satisfies part of energy demand.

- High efficiency and reduced pollution emission.

- Waste heat can be recovered to generate hot water and steam, which can be used for district heating and cooling and industrial processes with less pollution emissions.

- High efficiency cycles, e.g., combined cycles.

- Higher efficiency, less energy consumption and pollution.

- Waste minimization and recycling (and treatment) technologies.

- Lower cost of raw materials and energy (process plants).

- Less pollution.

- District heating (municipal waste and industrial waste).

- Reuse of resources.

- Recycling (process plants).

- Electrical load management.

- Control present and future load demand.

- Minimize electrical losses.

- Establish a model to monitor energy consumption and pollution emissions from industry as well as a monitoring centre (laboratory) for air and water quality.

8.3 Strategy for the Agriculture Sector

Involves the following aspects:

- Education, training, and awareness in this sector are especially needed to enable farmers and technicians to:

- Grasp the basic technical knowledge of the operation of agricultural machines, tools and engines according to their handling load and application. This would prevent unnecessary energy loss and misuse of equipment which could cause technical problems in the long run.

- Grasp the basic technical knowledge of routine preventive maintenance.

- Water pumps and engines used for irrigation should be sized for the specific purposes; i.e., capacity, power and technical specifications should be taken into consideration, and high-efficiency motors and engines should be selected for use. An incentive policy is recommended in this regard.

- Renewable energy may be conveniently applied in this sector as follows:

Solar energy	<ul style="list-style-type: none"> - water pumping - electricity generation - crop-drying - cooling
Wind energy	<ul style="list-style-type: none"> - water pumping - electric ity generation
Biogas energy	- production of biogas from agricultural and animal wastes to generate hot water and electricity.
Geothermal energy	- heating vegetable crop grown under plastic; commercial flower-growing operations.

8.4 Strategy for the Transport Sector

Air pollution is already a major problem in many built-up areas: the combustion of petroleum products used for transportation is one of the most significant sources of pollutants. Although this might not be the case in Jordan's transportation system, improvement measures should be taken to prepare for air pollution exceeding permitted standards. Air quality measurement programmes should be conducted regularly; moreover, a policy should be developed to deal with the reuse of lubricating-oil waste from vehicles.

Incentive policy measures can be applied to reduce energy consumption in the transportation sector.

Education, maintenance and small-scale energy and transportation management projects (The Ministries of Energy and Transport have already undertaken parts of these actions):

- Infrastructure: straightening roads, reducing of curves and slopes, decreasing roughness of roads.
- Traffic management: improving flow of traffic, traffic signal systems, restricting parking, introducing reversal lanes, improving the organization of one-way streets.
- Transportation management: for buses (routing and occupancy optimization) and for trucks (routing and load optimization).
- Occupancy of cars: incentives should be offered such as preferential parking and free parking for car pooling.
- Speed limits.
- Tyres: radial tyres (6% savings).
- Deflectors: aerodynamic drag-reduction devices, e.g., wind deflectors for trucks and trailers (4-14% savings).
- Maintenance: preventive maintenance and technical checkups.
- Technical development: better engines, improved aerodynamics, idling and coasting, weight reductions, transmission lubricants, petrol formula, electronic controls.

The following projects aim at achieving changes in regulations, government policies and laws: (any plans and programmes from the transportation sector must take into account energy efficiency, environmental protection and road safety requirements.)

- Licensing fees for cars.
- Tariff system for imported cars and spare parts.
- Transportation laws, including legal restrictions encouraging car pooling.
- Implementation of a training centre oriented towards energy conservation (established).
- Improvement of the vehicle test system (vehicle test centre).
- Establishment of governmental exhaust emission controls aiming at pollution reduction and energy conservation by road vehicles.

- A study considering the relaxation/lift on the import of diesel-engine passenger cars and taxis (dieselization), and on effects of refinery production on the environment.
- A study on gas-based fuel (LPG and CNG) to find a substitute for the gasoline engine. (Far fewer exhaust emissions, fewer oil imports, less vehicle maintenance.)
- Improvement in bus system services. (Energy conservation through increasing the effectiveness of public transit.)
- Energy conservation study on promotion of public passenger transport. (Viable, efficient, reliable, and convenient service at reasonable fares; more economical, less fuel consumption per passenger trip, less pollution.)
- Improvement of regular and preventive maintenance centres in the Public Transport Co. and concentration on energy conservation aspects.

8.5 Strategy for the Housing Sector

Efforts should be continued in an education and awareness campaign to offer technical advice to the public on saving energy through extension offices for energy. The number of extension offices should be increased and spread throughout the Kingdom.

Environmental as well as economic considerations must be incorporated into all aspects of energy policy. The aim should be to minimize the negative impacts.

To reduce reliance on traditional energy sources through the development of alternative energy resources, the policies should include:

a) Promoting the use of renewable energy, which at present makes little contribution to the energy balance. Increasing prices for petroleum products and natural gas can be expected to affect demand for energy in Jordan. In general terms, renewable energy such as solar and wind power, biogas and biomass will become more important and oil and gas less important. Encouraging private-sector participation in such development is deemed necessary.

b) Collection and analysis of necessary data for the development of renewable sources. Value judgements, as well as technical information about potential resources and production rates, are required. Social, environmental, health and economic considerations are all very important factors in deciding how Jordan should manage its non-renewable resources to develop a sustainable economy.

9 CHANGES TO ENVIRONMENTAL POLICY AND LEGISLATION

9.1 International Co-operation

Co-operation with international organizations. Earth and environmental sciences cannot be understood, nor their benefits realized, by studies confined to Jordan. Future strategy must be comprised of a combination of national and international programmes for research, survey and monitoring.

Jordan should co-operate and play an active role in the activities of the international organizations to study problems of management of the environment—in particular, UNESCO, the United Nations Environmental Programme (UNEP), the Scientific Committee on Problems of Environment (SCOPE) and all the international programmes aimed at carrying out integrated research in order to promote sustainable development of natural resources. Such co-operation should help develop a better understanding of the processes governing the evolution of the earth's crust, particularly with regard to the origin, extent and national use of the earth's mineral and energy resources. Fruitful co-operation on a bilateral and multilateral basis with other nations in environmental protection is contributing to the implementation of international agreements on the protection of the biosphere and its components.

Jordan should use the financial and technological assistance available from various sources such as development agencies, the World Bank, and NGOs such as IUCN to provide

greater protection for the environment, including EIA and action plans, and to promote energy efficiency.

9.2 Environmental Impact Assessment (EIA)

The main objective of an EIA is to attempt to identify and predict the potential environmental consequences of a proposed project. EIA can be undertaken at the feasibility study and early project planning stages, before issuing licences to implement a given project.

Advantages of an EIA: when an EIA is undertaken at the feasibility study and early project-planning stages, it can be a very useful aspect of the planning process. Alternatives with regard to siting of the plant, manufacturing processes, raw materials, pollution control techniques, waste disposal methods and type of finished products with their corresponding environmental consequences can be assessed. By investigating such options and their impacts, the quality of the final decision is improved.

The present situation in Jordan: EIAs have been undertaken at the feasibility study stages for a few major projects. However, Jordan has not yet had the opportunity to make a detailed assessment of the current and target status of the environment, nor therefore to promulgate relevant legal provisions. It is nevertheless widely recognized that the same emission standards are not necessarily applicable to each and every situation. It is environmentally and economically desirable to assess each case on its individual merits.

Any prospective development should therefore be preceded by an EIA which should address:

- Present environmental status.
- Target environmental status.
- Type and quality of prospective emissions.
- Impact of emissions.
- Emission control.
- Control technology.
- Emission and environmental status monitoring.

9.3 Waste Management Policy

Mining industries involve many types of operations, use a wide range of manufacturing processes and produce an extremely diverse group of products, with applications in every kind of human activity. These diverse operations and the many potential uses and misuses of the finished products have given rise to many environmental problems.

Uncontrolled disposal of chemical wastes from these industries is now of great concern. However, we lack an inventory of unauthorized industries; nor do we know the type and quantity of the wastes they produce. Without such information it is difficult to formulate appropriate management policies and choose the right technology to deal with the problem. There is a wide range of treatment and disposal techniques available. Landfilling, for example, which is widely used, can pose serious environmental and health problems if not properly implemented and monitored. Therefore, the site has to be carefully chosen to ensure that there will be no contamination of surface or groundwater resources.

In general, effective hazardous waste management requires an integrated policy encompassing generation, collection, transportation, storage, treatment and final disposal operations.

The objective of safe waste disposal is to ensure that wastes are dealt with in a manner which protects human health and the environment, and which minimizes burdens placed on future generations. These objectives are achieved by employing the following:

- a) Proper site selection methods. This implies a comprehensive site-specific investigation and exploration programme.
- b) Multi-barrier principle (natural and technical barriers).

- c) Safety concepts.
- d) Proven technology.

Set up recommendations and guidelines for waste disposal in mining and related industries and activities regarding:

- a) Safety concepts.
- b) Site-relation criteria.
- c) Disposal performance criteria.
- d) Earth science data needed for site characterization.

Study and predict environmental changes induced by mining.

Introduce measures to reduce the adverse impact of mining on the environment.

Introduce measures for rehabilitating land and for using mining waste.

9.4 Noise Control Policy.

Operational noise and vibration are of major importance. The policy to deal with them should include:

- a) control of operations to minimize the effects of machinery and transport.
- b) appropriate timing of noisy activity.
- c) careful location and insulation of equipment.

9.5 Legislative Initiatives

Legislation in different countries shows a varied picture, depending on prevailing economic and social conditions. In Jordan, responsibility and authority in natural resource management are distributed among a number of organizations. However, the management of metallic and non-metallic industrial rocks and energy resources is under one ministry.

Special legislation on environmental pollution from the mining industry should be laid down which takes into account the requirements of economic development as well as international laws and standards.

Strategies and policies for managing natural resources have little value without the necessary legislative framework in which they can be implemented. Legislation on natural-resource development and protection can be best achieved through:

- Issuing an environmental law.
- Updating the mining law.

The mining laws of Jordan have to be rewritten to apply to mining exploration and exploitation on a scale of interest to foreign investors; local investors have little interest in long-term speculative mining ventures.

The first mining laws and regulations in Jordan were audited in 1926; they were strongly influenced by British law and the laws of 1911.

Following the adoption in 1934 of the Law of Quarries, the Jordanian government adopted in 1946 another piece of legislation called the Oil Mining Law, which separated oil and gas from the Mineral Act. All of these laws and regulations were in force until the Interim Mining Code No 44 of 1962 was adopted. It was not until 1964, after it had been sanctioned by the House of Parliament, that this latter act came into force as Mining Code No 8 of 1964. After the NRA was established, this law was integrated with the organization of Natural Resources Affairs Law No 12 of 1968. Subsequently, the mining regulations adopted under an earlier Mining Code Law, No 131 of 1966, were reissued in accordance with Law No 12 of 1968.

The Jordanian legislature has not yet dealt with environmental protection issues in the mining sector, an important aspect to be dealt with in a new mining law.

Energetic efforts have to be made to create a uniform system for monitoring the state of the environment throughout the country. Government ministries and departments, business enterprises, private organizations, and every member of our society should bear greater responsibility for nature conservation: those guilty of polluting the environment have to compensate for damage caused, and funds thus received would be credited to the budgets of central and local authorities to be used for conservation and protection of the environment.

10 INSTITUTIONAL CHANGES

Environmental issues can be dealt with appropriately only by eliminating institutional constraints. In Jordan, as is often the case elsewhere, one agency has policy and management responsibility, another research or assessment responsibility, and commonly there is no co-ordination or co-operation.

As mentioned earlier, the mining industry has a great impact on the environment (land, air and water), resulting in such adverse after-effects as depletion and pollution of water resources, development of hazardous geological phenomena, changes in the landscape and air pollution. Conservation of the environment requires a complex of measures for rational nature use and management, among them institutional change. For the mining and energy sector, the following institutional changes are recommended:

- Establishment of an environmental division within the Ministry of Energy and Mineral Resources.
- Establishment of a training centre to be attached to the Department of Environment.
- Establishment of a higher council for environmental protection and rational use of natural resources.
- Establishment of advisory committees.

10.1 Environmental Division

The main tasks of this division would be to:

- Co-ordinate the work and co-operate with the Department of Environment in all planning proposals and ongoing projects.
- Initiate/co-ordinate/supervise EIA studies related to energy and mining, review the results and present them for decision-making. The division would also request information, provide terms of reference for the study, maintain records of completed studies and other relevant information, and serve as a channel for the exchange of information and opinions on environmental matters among the concerned organizations.
- Recommend control and preventive measures for mining in Jordan with particular emphasis on the influence of surface and underground mining on the earth's surface, on surface structures, and on water and air.
- All industry-related projects should be subject to the approval of the Department of Environment after consultation with the concerned division.
- Assist management in defining objectives and goals, and in planning and developing special strategies to achieve objectives.
 - Analyze and make recommendations on alternative courses of action.
 - Ensure that the future implications of all decisions are taken into consideration.
 - Appraise the strengths and weaknesses of any new system.
- Initiate special studies and research projects which will be of value to the future of the country as a whole.

Monitoring programme. The aims of resource management can also be achieved through a monitoring programme, which helps to improve the planning, development, protection and

What are the Objectives of a Monitoring Programme?

Monitoring attempts to identify correlations between parts of the system, in order to make recommendations to management bodies on where and how to impose the most effective control. Monitoring strives to:

- a) ensure compliance with legislation.
- b) anticipate future problems at early stages of development.
- c) provide information to improve designs and methods of exploitation.
- d) defend against specious claims.

Objectives of atmospheric monitoring are to:

- a) identify and quantify emissions to the atmosphere.
- b) check that emission controls are operating effectively.
- c) ensure environmental impact is kept at a minimum.
- d) ensure that companies comply with regulations.

Objectives of water monitoring are to:

- a) assess the water management and treatment system.
- b) monitor the impact of discharged effluents.
- c) ensure compliance with the water discharge licence, which states that "no matter deleterious to public health or livestock will be discharged."

management of mineral resources, to anticipate or reduce threats of pollution and depletion problems and to enhance anti-pollution policy. It also provides valuable information for implementing legislative and control measures. Monitoring has been defined by the United Nations Environmental Programme as "the process of collection of a time-series of data to measure trends as well as understand how a system works."

10.2 Research and Mapping

Research projects. Ideally, these should be reviewed annually when the programme of the division are formulated. This gives decision-makers the opportunity to reconsider what is appropriate for government funding. However, some additional urgent research project may arise at short notice. It is not possible, therefore, to make a definitive statement on the division's research programme in advance, but attention should be focused on:

- Preparation of thematic maps.
- Preparation of environmental geology maps.
- Geological research.

Thematic maps. Thematic map production means the collection, exchange and interpretation of earth science data and their presentation in cartographic form. From the databases, supplemented where necessary by special surveys, a range of thematic maps has to be produced, each addressing individual aspects of resource-related or environmental geology, such as mineral resource evaluation, energy resources and ground stability. These maps are particularly useful, therefore, in or adjacent to urban and industrialized areas where people and property may be at risk from unpredictable ground conditions caused by mining subsidence, the settlement or movement of unstable superficial deposits, dissolution and pollution. In addition, thematic maps that provide assessments of the quantity and quality of deposits of minerals represent a comprehensive factual background against which planning decisions can be made.

The divisions should commission geological research to provide essential information for making plans and decisions about the use of land. Failure to take geological information into account can lead to damage by geological hazards, e.g., landslips, subsidence and floods. If geological information is available, development can be restricted to safe areas, design precautions proposed and adequate warning of geological risks given.

Knowledge of the location of mineral resources helps in planning their extraction, including safeguarding future resources against sterilization by other forms of development. Geological information can also minimize air pollution and risks to water supply and is a major factor in planning for landfills and the disposal of wastes (including radioactive material), and in the investigation of contaminated land.

The division must guide the activities in the relevant disciplines, in disseminating information on findings regarding prediction of landslides and earthquakes, and should encourage the use of this knowledge in education systems.

The division's staff should include members qualified in disciplines such as economics, engineering, geology, ecology, chemistry, statistics and management science.

Similar divisions can be established in the other concerned ministries, such as the Ministry of Agriculture, Ministry of Water and Irrigation, Ministry of Transport and Ministry of Health. All the environmental divisions should co-operate and co-ordinate their work with the Department of Environment. To achieve this, the Department of Environment should be restructured to deal with the new situation and should be developed continuously.

Importance of environmental geology maps. Environmental geology is the study of geological factors that have relevance to human welfare, health and safety. Environmental geology maps of Jordan should be prepared as a means of conveying relatively simple messages regarding the geological implications of areas for planners, engineers and other non-geologist users. These maps are particularly important tools for the many areas which have suffered successive developments.

Training programmes. There is an urgent need for various kinds of training programmes if environmental projects are to be successfully implemented. These include:

- Specialized training in colleges, universities and local institutions. The geology and environment departments at Yarmouk University should be strengthened.
- Short-term training in foreign countries.
- Intensive on-the-job training.
- Training of technicians, both locally and abroad.
- Education of decision-makers and politicians through national and regional seminars.
- Creation of public awareness of environmental problems and the provision of experts in environmental education for institutions of higher learning.

A training centre should be established within the Department of Environment to be responsible for arranging, supervising and implementing all the above-mentioned training programmes.

10.3 Higher Council for Environmental Protection.

The council should be entrusted with monitoring compliance with environmental legislation and fulfilment of environmental protection plans. This governmental council would also co-ordinate environmental management activities, propose additional measures for raising their effectiveness and examine relevant problems. Its decisions should be mandatory for all government ministries and departments, as well as for private organizations and enterprises.

10.4 Advisory Committees.

It is inevitable that conflict will occur between the energy and mineral development industries and other sectors utilizing natural resources. The basic function of the proposed advisory committees would be to discuss and resolve environmental and social concerns and to make the most of the economic benefits brought to the people by the various companies. They would also have to deal with local concerns and ensure that development take place with minimal environmental and social disruption.

These committees could provide a continuing liaison between the government and the communities that may be affected by the development. They could have members from departments and agencies, industry and the general public and would advise on the need for and scheduling of programmes that provide public services in the areas affected by a given development project. The committees would deal and review concerns of residents over the possible effects of development and would bring these concerns to the government's attention.

Issuing a royalty system. A Mineral Royalty Rates Act should be issued to specify the manner in which mineral royalty rates should be determined.

11 PUBLIC AWARENESS, CONSULTATION AND PARTICIPATION

Public awareness of environmental issues has slowly but steadily grown. It would seem as if man has suddenly not only become aware of his environment but also of the fact that his continued survival depends on that environment.

Public awareness of the terrible consequences of environmental pollution, in particular that caused by industrial pollutants, is a relatively recent phenomenon in Jordan's society. Pollution problems have heightened public awareness and have led to a considerable number of activities conducted by various institutions, public and private, that deal with the scientific, technological, socio-economic, legal and commercial aspects of what has come to be known as the environmental problem.

In the past, planners long ignored the importance of including the people most affected by a project—the local residents and knowledgeable non-governmental organizations—in the planning process. Development will not be sustainable, however, unless the needs of people are identified and unless local residents support the project at a grass-roots level. Local people often provide the best sources of information for the design and implementation of rural development projects. Those who should be involved include not only the communities directly affected by the development projects but also voluntary agencies, farmers, co-operatives, schools, universities and private enterprises, all of which constitute unique sources of information useful to planning and implementation.

It is hoped that a co-ordinated plan will be developed that will be best for industry, the environment and society, and particularly for local residents. Development of a plan that adequately addresses this range of interests requires early and full public involvement and a complete economic, social and environmental impact assessment, including impacts on both human and animal health.

Improvement of knowledge concerning the ecological, social, moral and cultural implications of the interrelationships between man and his environment for a better design for living in human settlement can be done through:

a) Distributing information.

- Information can be propagated by special offices for public services. These offices can merge with the existing offices of the Ministry of Energy and Mineral Resources or work separately.

- Government should provide information in the form of case histories of environmental problems which have been solved or alleviated. Strong efforts should be made to enhance environmental awareness and to organize training on mining pollution and methods of control.

- R&D programmes underway in many countries address the gaps between identifying hazardous pollutants and the development of effective treatment. The status and planned activities of these R&D programmes should be made available to the public.

- International co-operation. There is a need for world-wide exchange of information on mining pollution and methods of controlling it.

b) Developing the existing educational curriculum.

c) Developing and promoting public environmental education.

- Audio-visual material and posters concerning the findings of various projects related to the environment should be prepared to inform the public, planners and those responsible for land-use management; environmental education could be improved by preparing and distributing teaching materials and brochures based on the results of these projects.

- Contribute through public education and awareness-raising to the improvement of the human environment and to the perception of its quality by initiating and co-ordinating studies on the scientific bases for the integrated management of natural resources.

12 INFORMATION SOURCES

12.1 Noteworthy Research and Technical Documents

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- Attyat, Abd El Rahman. Study of the water pollution by heavy metals in Zarqa River and its catchment.
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- Gharaibeh, S. High rates of domestic sewage sludge on a calcareous soil and their affect on wheat growth using a pot experiment; The environmental impact of the Akider waste dump site in north Jordan; Occurrence of Benzo (a) pyrene in combustion effluents of kerosene and diesel burners; Treatment and recycling of solid waste and sludge; Treatment and recycling of waste water; Environmental pollution and human ecology.
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- Ta'ani, R. Techno-economic pre-feasibility study for various solar and wind energy waters pumping systems.

- Taqieddin, S. (1990). Some Environmental Aspects of Jordanian Phosphate Mining Processes.
- Taqieddin, S. A. (1989). Industrial explosives and environment: revised.
- The effects of nuclear radiation on man and his environment and intercomparison measurement for determination of radio-nuclide in milk powder samples and intercalibration of environmental TLD cards.

12.2 Recommended Site Visits for a Rapid Appraisal

Several field sites may be visited by investigators wishing to make a rapid appraisal of the environmental conditions which are discussed in this chapter. Note, however, that these sites have not been selected comprehensively, and that other sites may also warrant visitation:

Phosphate Company.
Mining operations in Hasa, Abyad, Shadiya. Dump areas in Russeifa.
Arab Potash Company.
Ma'an and Husseinieh Quarries.
Aqaba: Fertilizer Company.
Power Station.
Port: phosphate and fertilizers.
Jordan Petroleum Refinery Company, Zarqa.
Hussein Power Station.
Daba Marble.
Hot springs in Zara, Zarqa Ma'in, Afra, Burbaita, Himmeh.
Ras Naqab Glass Sand.
Cement Factories: Fuheis, Rashadiyya, Khalidiya.
Baq'a and Ain Basha: Sand Quarries.

ANNEX 1 ENERGY TABLES

Table 1 – Growth in Number of Customers Using Electricity (000's)

Year	Jordan Electricity Authority	Jordan Elect. Co.	Irbid Elect. Co.	Munic. and Private Projects *	Grand Total	Annual Increase Rate %
1984	45.0	231	85.0	1.0	362.0	12.1
1985	51.5	253	96.0	0.5	401.0	10.8
1986	55.5	272	102.0	0.5	430.0	7.2
1987	60.0	292	107.5	0.5	460.0	7.0
1988	63.0	306	113.5	0.5	483.0	5.0
1989	66.3	317	118.0	0.3	501.6	3.9

*Supplied gradually from the Authority's networks.

Table 2 – Crude Oil Imports and Local Production @ Azraq ('000 Tons)

Year	1984	1985	1986	1987	1988	1989
Imported	2,616.4	2,480.7	2,282.1	2,537.8	2,428.5	2,457.1
Azraq	-	2.8	14.6	21.1	15.5	9.5
Total	2,616.4	2,483.5	2,296.7	2,558.9	2,444.0	2,466.6

Table 3 – Imports of Refined Products ('000 Tons)

Product	1984	1985	1986	1987	1988	1989
LPG	5.0	10.0	7.0	17.0	20.2	17.3
Diesel Oil	-	-	49.8	64.7	8.0	118.0
Fuel Oil	138.8	394.6	608.9	649.3	597.0	460.6
Total	143.8	404.6	665.7	731.0	625.5	595.9

Table 4 – Oil Shale Reserves in Jordan (in billion tons)

<i>Site Location</i>	<i>Amount</i>	<i>Total Oil Content</i>
Lajjun	1.196	Average 10.5%
Sultani	0.942	3.2–17.2%
Jurf Darawish	8.056	1.1–14.9%
Attarat Um Ghudran	11.300	9.0–13.0%
Wadi Maghar	21.600	5.5–9.0%
Total	43.094	

ANNEX 2 ENERGY AND MINING RESOURCES CURRENTLY EXPLOITED IN JORDAN AND DEGREE OF ENVIRONMENTAL CONCERN

Resources Currently Exploited in Jordan	Priority of Environmental Concern		
	<i>Low</i>	<i>Medium</i>	<i>High</i>
<i>Non-metallic minerals & industrial rocks & energy resources</i>			
Hydraulic		✓	✓
Phosphate	✓	✓	✓
Glass Industry: Dolomite, Feldspar, Glass Sand	✓	✓	✓
Building Stones: Limestone, Aggregates:		✓	✓
Sand, Gravel		✓	✓
Potash		✓	
Cement Raw Materials: Limestone, Clay, Gypsum, Tuff, Zeolite		✓	
Ceramics Industry: Clay, Feldspar	✓	✓	
Decoration Stones: Marble, Travertine, Alabaster, Granite	✓	✓	
Calcium Carbonate Industry: Limestone	✓	✓	
Oil	✓		
Gas	✓		
Geothermal	✓		
Solar	✓		
Wind	✓		
Rock Wool Industry: Basalt	✓		
Rock Salt	✓		

ANNEX 3 METALLIC MINERALS IN JORDAN

The following discussion of the mineral resources of Jordan evaluates each mineral as to whether prospecting and exploration could eventually lead to economic exploitation. Knowing the location of mineral deposits which may be developed provides a clue as to the type of terrain and other impacts which could be anticipated.

A-3.1 Copper

Occurrences: copper is the most widely known metallic mineral occurrence. Copper mineralization occurs in a belt of 20 km width and extends for about 70 km along the eastern side of Wadi Araba. The most important occurrences are:

- 1) Wadi Abu Khusheiba. The dominant copper mineralization in the sandstone occurs in the form of small nodules scattered irregularly. Estimated reserves: 8 million tons with an average grade of 0.5% or 0.8 million tons with grade of 1% Cu.
- 2) Feinan. Found within the sandstone and on top of dolomite and shale. Estimated reserves: 60 million tons with an average grade of 1.36% and an average thickness of 2 m.
- 3) Other Areas: Khirbet Nahas, Wadi Hamr, Salawan and Um Amad.

Extensive geological, mining, ore-processing and metallurgical beneficiation studies showed that exploitation of copper in the Feinan area is at present not economically feasible. The chances of exploration for the definition of further reserves of higher grade copper ore are considered to be good. Exploration work is still in progress.

A-3.2 Manganese and Iron

Manganese. **Occurrences:** manganese mineralization has long been known of on the east side of the northern Wadi Araba, in the Wadi Dana and Wadi Hamr areas.

Reserves: from the extensive exploration activities carried out by the NRA in the Wadi Dana area, the ore reserves are estimated to be approximately 1.5 million tons assaying 38% Mn and 1.4% Cu. The possible reserve is 5 million tons.

The manganese deposits are not exploited yet. Pre-engineering and special beneficiation studies showed that physical beneficiation processes did not meet marketing specifications. Chemical processes yielded the highest recovery, with 98.9% Mn and 95% Cu of the metal content in the ore. Evaluation of available information indicates good chances for defining further manganese deposits. Work is still in progress.

Iron. Iron ore was mined in Jordan until the late medieval period and possibly until the 18th century (Warda area, 7 km west of the village of Burma). The estimated remaining reserves amount to 561,000 tons of iron minerals. Evaluation of all geological information excludes a future discovery of a mineral ore deposit which would allow economic exploitation.

A-3.3 Cobalt, Nickel, Chromium and Vanadium

Cobalt. **Occurrences:** in the area between Wadi Huwar and Wadi Musa; Feinan district; and Ayn Al Hashim (south Jordan). Low cobalt values of concentration from these localities and the mode of their occurrence do not indicate the likely presence of exploitable cobalt mineralization in these areas.

Nickel. **Occurrences:** Wadi Dana, with manganese (0.01–0.1 of Ni); and Wadi Ghuweir, south of Feinan in andesitic lava (0.2–0.7%). Except for the Wadi Ghuweir area, there is no potential for successful nickel exploration.

Chromium. **Occurrences:** associated with marbles in the Qatrana-Siwaqa area; found along the Jericho-Jerusalem road (West Bank). The very low metal content and the mode of occurrence do not justify further exploration.

Vanadium. **Occurrences:** the Vanadium content averages 1000 ppm VO in the extractable phosphorite reserves of the Russeifa, Hasa and Wadi Abyad areas. This would amount to approximately 100,000 tons of VO. Cost of extraction is very high. Recent geological, geophysical and geochemical studies have shown that the Precambrian Shield of southwestern Jordan has potential for precious metals and possibly rare earth minerals. Exploration is still in progress.

ANNEX 4 INFORMATION ON WORKING GROUP

A-4.1 Current Membership of Working Group

Name	Affiliation
Dr. Ibrahim Badran (Former Sec. Gen.)	Ministry of Energy and Mineral Resources
Eng. Asem Ghousheh (Present Sec. Gen.)	Ministry of Energy and Mineral Resources Head of the group
Eng. Bassam F. Surna (Dir., Geology Direct.)	Natural Resources Authority Rapporteur and deputy chief of the group
Eng. Samir Kilani (Researcher)	Department of Environment
Eng. Abid Ruhman Kilani	Ministry of Industry and Trade
Mr. Mustafa M. Salma (Head of Chemical Studies and Env.)	Jordan Phosphate Mines Co. Ltd
Eng. Mohammad A. Jariri (Head of Chemical and Environment Sec.)	Hussein Thermal Power Station, Jordan Electricity Authority
Eng. Bashar Issa (Chemical Eng. Process Dept.)	Jordan Petroleum Refinery Co.
Dr. Nageh Yousef Al-Akeel (Head of Air Pollution and Hazardous Chemicals Division)	Environment Research Centre, RSS Representative of the Jordanian Society for the Control of Environmental Pollution
Eng. Jamal Fahmi Shweikeh (Chemical Industrial Eng.)	Energy Conservation Section
Eng. Izzat Abu Humra (Researcher)	Department of Environment

ANNEX 5 INFORMATION ON KEY SOURCES OF SECTORAL KNOWLEDGE

A-5.1 Names and Addresses of Technical and Lay Informed Persons

Eng. K. Jreisat	Natural Resources Authority
Eng. M. Abu Ajamiyah	Natural Resources Authority
Dr. Y. Hamameh	Natural Resources Authority
Eng. M. K. Omari	Natural Resources Authority
Mr. K. El Kaysi	Natural Resources Authority
Mr. A. Rousan	Natural Resources Authority
Eng. M. Haddad	Natural Resources Authority
Dr. I. Jallad	Jordan Phosphate Mines Co. Ltd.
Dr. A. Abu Hassan	Jordan Phosphate Mines Co. Ltd.
Mr. S. Madani	Jordan Phosphate Mines Co. Ltd.
Mr. N. Hammadi	Jordan Phosphate Mines Co. Ltd.
Mr. A. Mubaideen	Jordan Phosphate Mines Co. Ltd.
Mr. M. Badrakhan	Jordan Phosphate Mines Co. Ltd.
Mr. M. Salma	Jordan Phosphate Mines Co. Ltd.
Dr. M. Al-Souy	Mu'tah University
Dr. I. Mahasneh	Mu'tah University
Dr. S. Al-Taweel	Mu'tah University
Dr. H. Sallahat	Mu'tah University
Dr. A. Abu Shamlah	Mu'tah University
Dr. K. Al-Tarawna	Mu'tah University
Dr. J. Shakanbeh	Mu'tah University
Dr. F. Ghraibeh	Mu'tah University
Dr. A. Dhemat	Mu'tah University
Dr. H. Khoury	University of Jordan
Dr. G. Safarini	University of Jordan
Dr. S. Taqieddin	Jordan University of Science and Technology
Dr. T. Al-Khedawi	Jordan University of Science and Technology
Dr. R. Ta'ani	Royal Scientific Society
Dr. M. Amr	Royal Scientific Society
Dr. M. Mahmoud	Royal Scientific Society
Mr. S. Suradi	Royal Scientific Society
Dr. O. Sbay	Royal Scientific Society
Dr. E. Al-Ali	Royal Scientific Society
Dr. M. Amro	Royal Scientific Society
Dr. N. Yousuf	Royal Scientific Society

Eng. R. Assy	Royal Scientific Society
Eng. A. Al-Hassan	Royal Scientific Society
Dr. Moh'd S. Subbarini	Yarmouk University
Dr. M. Al-Abed	Yarmouk University
Dr. I. Al-Shunnak	Yarmouk University
Dr. S. Gharaibeh	Yarmouk University
Dr. M. Musmar	Yarmouk University
Dr. M. Rshidat	Yarmouk University
Dr. A. Atiyat	Yarmouk University
Dr. H. Al-Fugha	Jordanian Soc. for the Control of Environ'l Pollution
Eng. A. Abu-Khjai	Jordanian Soc. for the Control of Environ'l Pollution
Eng. A. Al-Ajlouny	Jordanian Soc. for the Control of Environ'l Pollution
Mr. M. Al-Jariry	Jordanian Soc. for the Control of Environ'l Pollution
Mr. M. Al-Nimri	Jordanian Soc. for the Control of Environ'l Pollution
Eng. A. Abu-Rbiha	Jordanian Soc. for the Control of Environ'l Pollution
Eng. Ali Mur	Ministry of Energy and Mineral Resources
Mr. Husam Taher	Ministry of Energy and Mineral Resources
Mr. Mohamad Arafah	Jordan Electricity Authority
Mr. Walid Jaouni	Jordan Electricity Authority
Mr. A. Al-Sukhun	Jordan Petroleum Refinery Co.

A-5.2 Names and Addresses of Government and NGOs

Ministry of Energy and Mineral Resources	P.O. Box 140027, Amman
Natural Resources Authority	P.O. Box 2220, Amman
Jordan Electricity Authority	P.O. Box 2310, Amman
Jordan Petroleum Refinery Company	P.O. Box 1079, Amman
Ministry of Industry and Trade	P.O. Box 2019, Amman
Ministry of Municipal, Rural Affairs & the Environment	P.O. Box 1799, Amman
Ministry of Water and Irrigation	P.O. Box 5012, Amman
Cement Factory	P.O. Box 610, Amman
White Cement Factory	P.O. Box 960403, Amman
Arab Potash Company	P.O. Box 1470, Amman
Ceramics Company	P.O. Box 1421, Amman
Calcium Carbonate Companies	P.O. Box 1059, Amman
Jordan Carbonate Company	
Jordan Turabeh Corporation	P.O. Box 926979, Amman
Glass Company	P.O. Box 3079, Amman
Rock Wall Company	

Jordan Phosphate Mines Co. Ltd.	P.O. Box 30, Amman
Royal Scientific Society	P.O. Box 925819, Amman
Royal Geographic Centre	P.O. Box 414, Amman
Higher Council for Science and Technology	P.O. Box 925967, Amman
Mu'tah University	P.O. Box 7; Karak, Jordan
University of Jordan	Amman, Jordan
Jordan University of Science and Technology	P.O. Box 3030, Irbid, Jordan
Yarmouk University	P.O. Box 2084, Irbid, Jordan
Jordanian Society for the Control of Environmental Pollution	P.O. Box 922821- Amman, Jordan

• Population

POPULATION STATUS

Jordan's population has grown rapidly during the past four decades. Official estimates in 1952 indicated that Jordan had a population of approximately 586,000. In November 1961, when the first population census was conducted, a population of 900,800 was counted. Accordingly, the annual growth rate of population during the period 1952-1961 was 4.9%. The second and most recent population census, carried out in November 1979, revealed that Jordan's population had exceeded two million (2,147,000). At present, the population of Jordan is estimated to be 3,571,000¹⁹. This put the average annual growth of population over the period 1952-1991 at 4.7%.

1 Growth Rate

The high rate of population growth occurred because of the following factors:

Mortality. There has been a decrease in mortality rates, resulting from the country's significant progress in providing health care and medical facilities to the general public. Coupled with better living standards, the gap between birth rates and death rates in Jordanian society widened. A reduction in the crude death rate has occurred, from 18 per thousand population in 1961 to 11.8 per thousand by 1979. During this same period, the birth rate increased from 47.3 per 1,000 population to 50 per 1,000. In fact, Jordan has the second highest fertility rate in the world—6.6 live births per woman.

Immigration. Political instability and military conflicts in the region fostered several waves of immigration to Jordan by Palestinians moving out of the West Bank. This circumstance has greatly influenced Jordan's development efforts. The most recent example is the return migration of some 200,000 Jordanians and Palestinians from Kuwait and Saudi Arabia due to the Gulf crisis.

Manpower shortages. Manpower shortages which prevailed in Jordan during the energy crisis of the mid-1970s resulted in the influx of large numbers of non-Jordanian workers to service the domestic economy. Also contributing to growth is the fact that Jordan has the second highest fertility rate in the world at 6.6 live births per woman, the inflow of non-Jordanian workers; and the National Population Commission projects a Jordanian population of 3,098,000 in 1995; 4,849,000 in the year 2000; and 5,670,000 by 2005. (Table 7, Annex 1).

2 Major Characteristics

Other characteristics of Jordan's population relate to age structure, population distribution, infant mortality, fertility and life expectancy.

Age structure. According to the 1979 population census, the proportion of the population less than 15 years of age was 50.7%. This proportion is expected to decline to 43.7% in 1990 and to 39.8% in the year 2000. (See Table 1, "Jordan: Summary of Demographic Indicators". The current pattern of population structure and its expected future trends reflect an increase in the dependency ratio in Jordan, which is high by international standards. The dependency ratio in Jordan is 1:5, while it is 1:3 in developing countries and 1:2 in industrialized countries.

Population distribution. With respect to population distribution, 88% of the population inhabits the northwestern region of Jordan. The Amman Governorate accommodates 43%, while the Irbid, Zarqa and Balqa areas accommodate 24%, 14% and 7% of the population.

¹⁹Source: National Population Commission

respectively. In contrast, only 12% of the population lives in the southern and eastern parts of the country. (See Table 2, "Population Density and Distribution by Governorates".)

Several factors influence the concentration of population in the northwest. Primarily, these are the availability of agricultural land, water resources, and modern sources of livelihood. The endowment of natural resources is reinforced by urban settlements offering a higher standard of living, better education and health facilities, and the availability of permanent, higher-paying jobs.

This pattern was further influenced by the uneven distribution of investment projects among regions, as well as the drop in agricultural productivity due to bad weather conditions, and depletion of the natural resource base. Presently, approximately 70% of Jordan's population resides in urban areas, and rural-to-urban migration continues.

Infant mortality. The infant mortality rate declined from 162 per 1,000 in 1950 to 87 per thousand in 1980, and to 45 per thousand in 1990. The rate is expected to decline still further to 36 per 1000 by the year 2000. (See Table 3, "Decline in Infant Mortality Rate.")

However, the crude death rate was 6.2 per 1,000 population in 1990, and is expected to decline to 5.5 per 1,000 in the year 2000. At the same time, the crude birth rate was 34.6 per 1,000 population in 1990, and is expected to decline to 32.3 by the year 2000. As a consequence, the natural increase of population will show a slight decline from 2.8% in 1990 to 2.7% by the year 2000.

Fertility and life expectancy. Total fertility rate increased from 7.3 in 1961 to 7.8 in 1979; however, this rate declined to 5.5 in 1990 and is expected to decline further to 4.4 by the year 2000. The fertility rate in Jordan is triple that which prevails in industrialized countries.

Life expectancy at birth has increased, due to improvement in preventive medicine and other health facilities, from 46 years in 1961 to 66 years in 1990. Life expectancy at birth is expected to increase to 68 years by the year 2000. Rates for females and males differ. Female life expectancy improved from 47 years in 1961 to 68 years in 1990, whereas that for males increased from 46 years to 64 years within the same time span.

Age and Sex. The pattern of age and sex structure of the Jordanian population is very similar to that of its neighbouring Arab countries. (See Table 1, "Jordan: Summary of Demographic Indicators for Selected Years".)

In summary, Jordan has a high rate of natural population increase which will persist to the end of the decade. Even though Jordan's growth rate is expected to decline to 3.1% by 2000, it will still be among the countries having the world's highest population growth rate.

2 SOCIO-ECONOMIC IMPLICATIONS²⁰

There is no doubt that high and rapid population increase has great effects on the development processes on the one hand, and the disturbance of population distribution on the other. In Jordan, the population increase has had negative effects on the environment in terms of concentration around urban areas and main cities where the demand on social and security services and public facilities such as the sewage systems increases. That leads to decreasing the capacity of these facilities to meet all demands resulting from the rapid population increase and the emergence of unplanned slum and squatter areas which lack most services and basic facilities. All that leads to the emergence of environmental pollution due to dumping wastes in the alleys and open yards or burning wastes in an unhealthy way, emitting smoke and gases which pollute the air into the area. This is reflected in the emergence of large and numerous population settlements at the expense of agricultural lands (thus decreasing agricultural productivity), on the one hand, and increasing unhealthy practices by the population on the other.

²⁰Submitted by: Mr. Hussam Akkawi, Rapporteur, Housing Corp.; Mr. Ahmad Al-Fandi, Housing Corp.; and Mr. Walid Ya'qub, Housing Corp.

2.1 Distribution of Population by Governorates, Urban and Rural

There is a great variance in population distribution among governorates in Jordan (Table 4). Amman and Zarqa have almost 57% of the total population of the Kingdom, followed by Irbid 24%, Balqa 7%, Karak 4%, Mafraq 3.5%, Ma'an 3.0% and Tafila 1.5%. This variance indicates continued local immigration towards Amman and Zarqa, which is attributed to the availability of pole factors in these two governorates such as social and government services and centres; whereas other governorates have population push factors such as the lack of higher educational institutes (whether academic or professional) and other government centres.

The annual growth rate in Amman and Zarqa reached 3.3% during the period from 1979-1989, whereas it was 2.9% in Irbid, Mafraq and Balqa, 2.6% in Karak, and 1.9% in Ma'an. The variance in distribution (urban and rural) seems more apparent; 70% of the population in 1989 was urban and 30% rural. The pattern of local immigration shows a trend in movement towards urban areas, which leads to a decline in rural population and abandoning agricultural lands. This leaves the agricultural sector without a resident labour force, and increasing the rate of urbanization, which contributes to the dominance of Greater Amman over other cities.

High urban population densities may adversely affect environmental health in terms of social, economic, and security implications. An unresolved question is how the net loss of rural population will affect the land-use pressures on the natural environment.

2.2 Economic Characteristics of the Population

Table 5 shows that the Jordanian society is a young one in which the percentage of young people (under 15 years old) is 48.1%. This increases the burden of support and decreases the worker's productivity, since almost half the population is not active economically; in addition, there are housewives, landlords, pensioners without work and high school and university students. The support rate has increased to 1:6, including the worker himself. This has led to decreasing the labour force rate to 16.8% of the total population and that is attributed to the low participation of Jordanian women in the work force; the figure does not exceed 15% of the total female population of working age. This leads to a decreased individual share in the national income on the one hand, and subjects a person to disease caused by malnutrition and shortage of social services on the other. These are considered unhealthy environmental problems which can be attributed to the deterioration of the economic situation, increased external debt and decreased exchange rate of the Jordan dinar in recent years.

2.3 International Immigration – Aftermath of the Gulf Crisis

It is expected that the number of families returning from the Arab Gulf area, particularly Kuwait and Saudi Arabia, due to the Gulf crisis will have a substantial impact on Jordan. More than 200,000 people returned to Jordan in 1991 and the following outcome may be expected:

- Increased unemployment rate.
- Increased concentration in urban areas where services are available.
- Loss of one of the sources of national income due to decreased rate of remittances, which will lead to a decrease in per capita income and living standards with all implications from that affecting health and environment.
- Increased rates of population occupancy (housing density, room occupancy rate), especially for low-income housing.

2.4 Distribution of Labour Force according to Profession

Jordan, like other developing countries, suffers from the dominance of non-technical traditional professions; the rate of technicians does not exceed 17% of the total labour force, as 83% are non-technical workers in clerical, administrative, service, production and agriculture jobs. This weakens the ability to transfer technology and modern practices, and at the same time poses an obstacle to developmental processes. It is well-known that traditional techniques increase the rate of material loss and misuse of resources, which causes deterioration of the natural, economic and social environmental resources (Table 6, Annex 1).

With respect to the environment, this means that environmental projects which are implemented in Jordan as part of the strategy-implementation phase must include a funding component for technical training, particularly for highly specialized occupations.

2.5 Distribution of Labour Force according to Economic Activity

Declining employment in agriculture. We have already mentioned that one of the results of rural immigration towards the cities is the movement of agricultural workers from rural areas, the rate of which did not exceed 7.5% of the total labour force in 1989. Another feature, which is a characteristic of developing countries, is the high rate of employees in the government sector, which is characterized by low productivity and a high rate of disguised unemployment. It is evident that the productive sectors are not dominant in the Jordanian economy, nor is the agricultural sector. This poses a danger to other economic activities, since most industries in Jordan are light ones which aim at replacing imports, and that increases dependency on the international economy and vulnerability to external crisis that could be transferred to the Jordanian economy, such as high rates of inflation due to high rate of imports (especially consumables). All that makes Jordan vulnerable to the disturbance of its food security and to the loss of strategic food supplies; this threatens the economic environmental safety.

2.6 Distribution of Labour Force According to Governorates, Urban and Rural

The Greater Amman area includes the biggest portion of population and of labour force: 42% in Amman, 24% in Irbid, 14% in Zarqa and the remaining 20% of the total labour force in the five remaining governorates (Balqa, Karak, Mafraq, Tafila and Ma'an). The labour force is concentrated in urban areas (71%), and the remaining 29% are in rural areas. We find that most workers in urban areas are engaged in financial services, industry and trade and construction in the following rates: 91%, 88%, 86%, 80%, respectively, and this exceeds the number of urban area population, as a large number of these workers live in rural areas and work in urban areas. It is also evident that industrial, professional, trade and service activities are concentrated in urban areas, which make them pole centres for the local and foreign labour force, concentrated mainly in the main cities.

It is well-known that industrial and professional centres pose a danger to environmental health through emissions of smoke and the various types of waste that lead to air pollution. The fact that most foreign labourers live in houses of high occupancy rates and suffer from malnutrition, in addition to practicing habits alien to Jordanian society, lead to negative effects on the social and health environment.

2.7 Population Issues and Development Planning

Since the mid-1970s, Jordanian planners and policy-makers have paid attention to demographic factors as they relate to the use of natural resources and prospects for socio-economic development. Pursuit of the development strategy which was adopted throughout the period 1976-1990 clearly showed that resource scarcity would limit long-term growth. In the absence of complementary resources, the scope for expansion in the domestic economy would be limited. In other sectors, water scarcity had already limited the

possibilities for agricultural expansion, while limited natural resources made it difficult for the mining—except phosphate—and manufacturing sectors to lead the economy.

The inclusion of population issues into development planning has become a matter of some urgency, if development is to achieve its aims. Accordingly, the Jordanian development strategy since the mid-1970s has clearly indicated the need to tackle major population issues through various policy measures. The key population issues are the following:

- Rapid increase in population.
- Uneven geographical distribution of population.
- Population migration:
 - a-Internal migration.
 - b-Emigration, including manpower emigration.
- Acceleration of urbanization.
- Population age structure.
- Education and the high proportion of population enrolled in schools, universities and other educational institutions.
- Low overall participation rate in economic activities.
- Low female participation in the economy.
- Rising unemployment rate among new entrants to the labour market.
- Rising demand for basic social needs, facilities and services, such as education, health, housing, energy and water.

Priorities. The Jordanian development strategy recognized that population factors would constrain economic growth and development, and therefore a genuine integration between population and development factors should be made. Accordingly, the rapid population growth rate issue was given highest priority by development planners. This was followed by the issues of population migration; the unbalanced regional distribution of population and the problem of unemployment.

3 ACTIONS FOR DEVELOPMENT

Although population factors have been identified as important issues vis-a-vis the country's economic growth and social progress, the government has not yet adopted an explicit population policy. However, in recognition of the importance of population issues, the National Population Commission (NPC) was established in 1973 to plan and promote a national policy. The NPC initially established its General Secretariat in order to meet the needs of planners and policy-makers for integrating population factors in development planning. However, the Commission lapsed into inactivity over the years, and it was only in 1988 that the government revived it. According to its mandate, the new NPC is to advise the government on all population-related matters and to undertake, promote and assist in conducting policy-oriented research studies.

3.1 NPC Objectives

(i) To limit the growth rate of population, in order to balance it with the country's available resources; and (ii) to undertake policy-oriented population research to satisfy future subsistence, income and lifestyle needs, within the bounds of natural resource availability.

To achieve these objectives, measures have been taken by the NPC to devise a population policy and to research the link between population, resources, and government services.

3.2 Birth Spacing as a National Population Policy

The justification of our adoption of birth spacing as a national population policy can be summarized as follows:

Detriments of close births. Close and recurrent births are detrimental to MCH. They weaken the health of women, who do not have enough time to recover their normal condition. They also deprive children of breast-feeding—so important to their immunity from disease—and of sufficient care and attention.

Statistics in Jordan indicate that 40% of women have seven children or more during their reproductive years, and 69% of women who are still in their reproductive cycle have four children or more.

It is noteworthy that close and recurrent births can cause diseases such as anaemia and diabetes. The more children a family has, the more vulnerable they are to disease.

Infant mortality. The risk of infant mortality increases in infants born during a period less than two years or more than four years between one conception and the next, whereas the risk is considerably reduced if the period ranges between two and four years. This period was mentioned in the Holy Qu'ran, which shows the importance of birth spacing for MCH.

Studies also indicate that death rates increase in mothers and children of mothers who have recurrent births and have six children or more. The rate is seven times that for women who have four children or more.

Cultural acceptance. We must respect the right of parents to decide the number of children they want to have, in harmony with the values and traditions of society. Birth spacing is in accordance with our understanding of religion, and with Jordan's role in the Arab world and its endeavours to safeguard its national security.

Close births are the result of unbalanced reproduction behaviour and the dangers they present to MCH mean that birth spacing must be the base of population policy in Jordan.

3.3 National Health Programme for Birth Spacing, NHPBS

For the purpose of reducing the population growth rate, the NPC adopted and issued a strategic initiative known as a National Health Programme for Birth Spacing, which is now under consideration by the government. The major theme of this programme is to rationalize fertility behaviour through adequate integration of birth-spacing services in the national health service. It is proposed that governmental and non-governmental organizations participate in adopting this programme, to ensure its success nationwide. Involvement of international organizations would help in achieving programme objectives.

In view of Jordan's considerable progress in providing health and educational services and also in light of its rapid economic and social development, the country's mortality rates and life expectancies are approaching those of the industrialized countries. However, the population growth rate remains high and close pregnancies are the rule rather than the exception. These latter phenomena highlight the need for practical measures that would deal with birth spacing as a national population policy related basically to MCH in Jordan; two aspects of such policy should be emphasized:

- Information and education: enlist citizens' support for this programme and teach them how to implement it in a way that does not contradict their religious beliefs.
- Practical aspects: provide the health centres around the country with the necessary means for those wishing to use birth-spacing techniques.

The National Population Commission has requested the General Secretariat to propose a national birth-spacing programme, so that they can take the necessary measures to implement it after it is approved by the Commission in its final form.

To be effective, a population strategy must be culturally acceptable. To this end, the NHPBS takes into account the religious and cultural values of Jordanian society, but a

public awareness campaign will also be necessary to ensure the programme's success. Public education and health education leading to popular acceptance of birth spacing will benefit mother and child health now, as well as in future generations.

3.4 Link Between Population and Resources

The NPC is conducting a series of studies under the title of "Population Growth and Basic Needs in Jordan: Future Outlook 1990-2005." A primary focus will be imbalances between population and available resources. These forward-looking studies cover the following areas of concern:

- Education
- Manpower and migration
- Health services
- Mother and child health
- Housing and public utilities
- Water and food security

In short, there is a clear need for a deliberate population strategy directly linked to available resources. Policies pertaining to such a strategy should consider cultural values, religious beliefs and social harmony. At this stage of economic growth and development, priorities should be directed towards achieving the following:

- a) Rational increase in population, through promotion of the NHPBS.
- b) More balanced geographical distribution of population.
- c) Reducing unemployment and increasing female participation in economic activities.

4 OBSTACLES AND ACTIONS

4.1 Obstacles

- High unemployment rate in the work market and the resulting social and security problems.
- High growth rates and increased immigration from rural to urban areas.
- Non-concordance of economic growth rate with population growth rates.
- High rates of illiteracy among labour force.
- High rate of unqualified, untrained labour force.
- Health, nutritional and housing conditions of foreign labour, and the local labour force who work in cities and other urban centres and go back to their residence areas in rural areas after work.
- Cost of training and teaching, and cost of preventive and curative medicine.

4.2 Actions to Solve Population Sector Problems

- a) Decrease fertility rates using healthy spacing of pregnancies through a clear population policy.
- b) Information and education and training of labour force with emphasis on illiteracy programs through labour and population education programs.
- c) Create population balance through creating investment and public service opportunities in rural areas and areas of push factors, and transfer them to pole centres to create reversed immigration.
- d) Decrease support rate and increase participation of women in the work market.
- e) Establish organizational and legal procedures to control pressures concerning the work market, unemployment, concentration in cities and increased immigration from rural to urban areas by providing services in rural areas to encourage settlement there.

f) Introduce preventive health awareness by setting up comprehensive programs in environmental health to complement national medical services and ensure a more suitable environment that will promote attraction factors in those areas and their productive capacity.

g) Co-ordinate and co-operate with international communities to deal with issues relating to international immigration.

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- Dr. Pietronella van den Oever, Co-ordinator, Population and Natural Resources Programme, IUCN-The World Conservation Union.

ANNEX 1 – POPULATION TABLES

Table 1 – Jordan: Summary of Demographic Indicators for Selected Years

<i>Age Group as a Percent of Population</i>			
<i>Age in years</i>	<i>1961</i>	<i>1990</i>	<i>2000*</i>
0–14	46.0	43.7	39.7
15–64	50.8	53.5	57.4
65+	3.2	2.8	2.9
<i>Other Indicators</i>			
Birth rate per 1000	47.3	34.6	32.3
Death rate per 1000	18.0	6.2	5.5
Natural rate of increase (%)	3.0	2.8	2.7
Total fertility rate	7.3	5.5	4.4
Life expectancy at birth (yrs)	46.0	63.0	68.0
For females (yrs)	47.0	68.0	70.0
For males (yrs)	46.0	64.0	66.0

Source: National Population Commission. * NPC projections.

Table 2 – Population Density and Distribution by Governorates in Jordan, 1990

<i>Governorate</i>	<i>Population</i>	<i>Density*</i>	<i>% of Population</i>
Amman	1,484,790	136	43.0
Irbid	828,720	328	24.0
Zarqa	483,420	96	14.0
Balqa	241,710	217	7.0
Karak	138,120	37	4.0
Mafraq	120,855	5	3.5
Ma'an	103,590	3	3.0
Tafila	51,795	23	1.5
Total	3,453,000	39**	100.0

Source: National Population Commission. *Persons per square km. **Average density for Jordan.

Table 3 – Decline in Infant Mortality Rate (IMR)
(Deaths Per Thousand Live Births in Jordan)

<i>Year</i>	<i>IM Rate</i>
1950	152
1960	126
1970	87
1980	63
1990	45
2000*	36

Source: National Population Commission, Population Information File.
*Projected. See National Population Commission, Expert Group Report concerning population projections for Jordan for the period 1990-2005. The General Secretariat, Amman, March 1991 (in Arabic).

Table 4 - Estimates of Urban and Rural Population by Governorate for 1988 and 1989

<i>Governor.</i>	<i>1988</i>			<i>1989</i>		
	<i>Rural</i>	<i>Urban</i>	<i>Total</i>	<i>Rural</i>	<i>Urban</i>	<i>Total</i>
Amman	185,750	1,062,830	1,248,580	192,015	1,105,085	1,297,100
Zarqa	41,475	392,525	434,000	42,805	407,095	449,900
Irbid	328,450	399,750	728,200	342,570	410,830	753,400
Ma'raq	75,350	30,100	105,450	77,790	31,210	109,000
Balqa	92,355	115,145	207,500	95,465	119,235	214,700
Karak	102,830	25,620	128,450	106,255	26,545	132,800
Tafila	26,915	17,355	44,270	27,810	17,990	45,800
Ma'an	48,460	56,090	104,550	50,030	58,270	108,300
Total	901,585	2,099,415	3,001,000	934,740	2,176,260	3,111,000

"Urban" includes localities of 5000 population or more as defined by the Dept. of Statistics in 1979. Source: Department of Statistics, Annual Statistical Bulletin - 1989.

Table 5— Population in the East Bank
distributed according to age group

<i>Age Group/ Year</i>	<i>1989</i>
14 and below	48.1%
15-64	49.3%
65+	2.6%
Total	100.0%

Table 6 - Distribution of Jordanian Active Labour Force by Occupational Activity in 1989.²¹

<i>Major Economic Activity</i>	<i>%</i>	<i>No.</i>
Electricity and Water	1.4	7,329
Finance and Insurance	3.1	16,229
Agriculture	7.2	37,692
Transport and Communication	8.8	46,068
Construction	9.7	50,780
Trade	10.2	53,398
Mining and Manufacturing	10.4	54,445
Social and Public Administrative Services	49.2	257,564
Total	100.0	523,505

Source: Ministry of Labour, Research Department.

Table 7 - Jordan Total Population for Selected Years

<i>Year</i>	<i>Total</i>	<i>Males</i>	<i>Females</i>
1952	586.2	301.7	284.5
1961	900.8	469.4	431.4
1979	2,133.0	1,115.8	1,017.2
1985	3,094.0	1,618.5	1,475.5
1990	3,453.0	1,777.0	1,676.0
1995	4,098.0	2,103.0	1,995.0
2000	4,849.0	2,483.0	2,366.0
2005	5,670.0	2,899.0	2,771.0

Sources: (i) years 1952, 1961 and 1979, Department of Statistics; (ii) 1985 to 2005, NPC Expert Group.

²¹ For more information see report of the Ministry of Labour for 1989.

ANNEX 2 – IUCN RECOMMENDATION ON HUMAN POPULATION DYNAMICS & RESOURCE DEMAND²²

The General Assembly of IUCN – The World Conservation Union, at its 18th Session in Perth, Australia, 28 November to 5 December 1990:

URGES IUCN members to take active steps towards integrating population and environmental issues by creating partnerships with competent organizations, particularly local organizations, in order to raise awareness, engage in demonstration projects and report on the experiences gained in these projects...

ENCOURAGES IUCN members and the IUCN Secretariate to continue to take the lead in exploring and initiating actions on the relations between:-

- a. population growth and distribution, finite natural resources and attainable quality of life;
- b. human population trends and the survival of other species;
- c. family size, changes in social and cultural behaviour and technologies, and patterns of resource use;
- d. natural resources management and human health, particularly the morbidity and mortality of infants and young children;
- e. over-consumption, urbanization, rural impoverishment and options for sustainable resource use and management;
- f. women in development and their role in the process of achieving environmental sustainability.

²²Source: resolution 18.17 of *Resolutions & Recommendations from the 18th Session of the General Assembly of IUCN-The World Conservation Union, Perth, Australia, Dec. 1991.*

8 • Housing and Settlements²³

1 CONDITIONS AND ISSUES

1.1 Housing Conditions

- Distribution of housing units according to type of residence and construction material: marginal (barrack, cottage, cave), mobile (ship, caravan, tent, big tent), traditional (house, villa, apartment).
- Distribution of housing units according to availability of services: potable water, lighting, heating, public sewerage system.
- Distribution of housing units according to number of rooms and families in the house.
- Distribution of housing units according to the state of the building: acceptable, needs repairs, unsuitable. For example, the housing situation in undeveloped and unlicensed housing areas; housing situation in camps.

Housing concentration in cities and unplanned urban zones. The estimated housing stock in Jordan was 460,000 houses²⁴ in 1986 and 516,000 in 1987²⁵. Around 73% of houses are in urban areas, and 27% are in rural areas. Successive official housing censuses reveal a concentration of construction in major cities, particularly in Greater Amman, where 34.5% of the total number of houses was concentrated in 1986, against only 26.2% in 1961. Houses in other urban areas increased to 38.3%, as shown in Table 1 (Annex 1).

This trend in construction has led to a large increase in demand for houses and services, which in turn has taxed the economy's ability to maintain living standards, and has weakened the government's ability to provide social services such as education and health care. The lack of sufficient social services has resulted in a deterioration of environmental conditions. For example, the lack of sufficient sewerage and proper waste disposal systems causes people to dispose of their waste in an unhealthy manner that affects the environment, by generating emissions of gases which pollute the air.

Slum and squatter housing. The phenomenon of slum and unlicensed squatter housing has emerged within established residential areas in a number of the main cities, like Joufeh and East Wehdar in Amman, and Shallala in Aqaba. Some of these settlements were established around main cities, where haphazard housing does not conform to zoning regulations and construction standards, land ownership is not clear, and in some cases a plot of land is owned by one person while the house built on it is owned by another.

Due to the vital link between housing and the environment, the phenomenon of housing concentration in urban areas generates great pressure on services and facilities, and reflects negatively on all aspects of environmental health. The inability of urban areas to meet housing demand leads to zoning violations such as unplanned slum and squatter areas that lack essential services and endanger environmental health.

1.2 Housing Issues

Inappropriate land use. The high concentration of population settlement in urban areas, especially in Amman, Zarqa and Irbid, resulted from the availability of services and job opportunities there. This has increased pressure on residential and agricultural lands in these cities; the number of houses which violate zoning plans at the expense of agricultural

²³Information in this chapter was prepared by the Population Committee, under the chairmanship of Eng. Yousef Hiasat, General Manager, Housing Corporation.

²⁴Estimates of the National Housing Strategy, Technical Memorandum No. 7, Existing Housing Situation- Ministry of Planning, 1987.

²⁵Estimate of the Department of Statistics.

lands and which lack the minimum social and recreational services has increased. Many housing settlements have been established on agricultural lands, in Greater Amman and other urban areas²⁶, especially in the southwestern and northwestern districts of Amman such as Bunayat, Jawa, Khreibet Souq, Um Uthaina, Marj Hamam, Suwaifiyeh, Bayadir Wadi Sir, Tla' Ali, Abdoun, Um Summaq and Khalda. Some settlements have also been established on water basin areas such as Baq'a Basin, which includes eleven housing settlements: Baq'a Camp, Midmad, Mathallat, Ain Basha, Safout, Moubis, Shobaji Sharqi, Shobaji Gharbi, Abu Nuseir, part of Sweileh, and Um Dananir. The population in these settlements is estimated at 130,000.

A study of the Baq'a basin area²⁷ conducted by the Ministry of Municipal and Rural Affairs and the Environment indicated the need for re-planning the area in order to overcome environmental problems constraining its growth, and for planning housing settlements in a way that suits the nature of the area, bearing in mind that most settlements are concentrated in the plain area of the basin, on substantial agricultural lands. Some settlements have also been established in archaeological and seismic areas; these settlements were not defined.

Occupancy rates. The 1986 housing survey revealed variable occupancy rates in different areas, in terms of the number of families and number of persons per house and per room, area, and number of rooms. The room occupancy rate is more clearly indicated in Table 2 (Annex 1).

The percentage of rooms occupied by one or two persons is 64.9% in the East Bank. Those in this category live within the international room occupancy standard of 2.5 persons per room, which is higher than the rate recorded in industrialized countries. The remaining 35.1% of people suffer from crowded housing conditions and the associated problems of lower educational, health and nutritional standards. Low educational and economic standards in many developing countries can be attributed to large family size, restricting opportunities for adequate health care and living conditions.

Low living standards correlate with low environmental health standards, because people resort to poor practices in using natural resources, such as improper disposal of wastes, over-grazing, and cutting trees for fuel, which increases agricultural soil erosion and desertification. Wrong use of chemical fertilizers and pesticides in agricultural areas leads to seepage of hazardous materials into potable and irrigation water sources, which threatens human health.

Available information on camps shows that the occupancy rate per dunum varies from 25-95 persons per dunum, the average occupancy rate is 55 persons per dunum, the average number of housing units is 6.5 per dunum, and the average building area of each housing unit is 145 square metres, including services and public facilities areas. The average occupancy rate per room is four persons.

In slum and squatter areas the average occupancy rate is 46 per persons per dunum; the occupancy rate in these areas is 3.2 persons per room, compared to 2.7 persons per room in the East Bank, as shown in Table 3 (Annex 1).

Scarcity of land and suitable housing. The main issues obstructing the development and use of available lands for housing are as follows:

- Extensive development of certain housing categories (a,b), and a great shortage of planned areas for other housing categories (c,d), which has led to increased demand for housing in the latter category and to a relative increase in their price.
- The high price of residential lands has affected the ability of a large segment of the Jordanian community to obtain suitable housing.

²⁶For more information, see the overall development plan of Greater Amman - Final Report 1988 - Amman.

²⁷Baq'a Basin Report - Dept. of Organization - Ministry of Municipal and Rural Affairs and the Environment, 1989 - Amman.

- There is a lack of small plots (around 150 square metres) for residential use in urban development projects to suit the target families' incomes²⁸.

Availability of public services and facilities. Generally speaking, basic water, sewerage, electricity and communications services reach most population settlements, though the variance in availability of services affects the suitability of houses for health and environmental purposes (Tables 8 & 9).

Available information at the Ministry of Planning²⁹ and the Greater Amman Municipality indicates the range of variance among different areas in terms of public services and facilities³⁰. In Balqa Governorate, for example, with 206,000 inhabitants or 7% of the total population of the Kingdom, the rate of beds available in health centres is one bed for every 1575 citizens. Forty-six population settlements have no health facilities, 56% of the total of 81 population settlements in the governorate have no paved roads, and 55% of settlements have no electricity, whereas 89% of the population have electricity; and 66% of settlements are connected to the public water network. The rest use other sources. Seventy-two percent of the population use the services of local councils for collecting wastes.

In Ma'an Governorate, the population is estimated at 107,000 inhabitants, i.e. 3.4% of the total population of the Kingdom, living in 102 population settlements; 55 of these have no health facilities, and 43 have no educational services due to the small population there; 74% of the population use public, agricultural, and internal roads, and 17% have no electricity because they live in more than 67 very small settlements.

In the Aqaba area electricity is available only in Aqaba city, Quaira, and some other population settlements; 93% of the population of the areas surrounding Aqaba have no electricity service, including all those in the Wadi Araba area. In Ma'an most houses use cesspools, and 35% of settlements use the services of local councils for collecting wastes. Ninety percent of population settlements receive water through municipality or Water Authority networks. In general, 35 population settlements in Ma'an Governorate are deprived of most basic services (communications, roads, electricity, water, sewerage system, waste treatment).

In the Greater Amman area, access to services and public facilities varies widely. The population in the southern area, which includes Naser, Hamdan, Taj, Ashrafieh, Wehdat camp, Quwaismeh, Abu Alanda and Rajib, is 245,000 inhabitants, or 25% of the total population of Greater Amman. Services in this area are concentrated in Wehdat and the new settlements in Abu Alanda, Ashrafieh, Quwaira, and Quwaismeh. The occupancy rate of 5-7 houses per dunum is one of the highest in the Greater Amman area. The shortage of schools in this area is critical, and it is in more urgent need of increased services than other areas of Amman.

The housing here differs from that prevailing in the western and northern areas, where the population density is lower (2 families per dunum in the western area, and 1 family or fewer per dunum in the northwestern area). Green areas and recreational facilities are more available in these areas than in others. The total population of the two areas is estimated at 164,000, which is less than that of the southern area.

Rural areas within Greater Amman include Shafa Badran, Koam, Yajuz, Marj Kursi and Tab Kra' in the north, and Bassa, Rabahiya, Deir Dra', Dabuq, Na'ir and Wadi Shta in the west. Large areas around the existing population settlements here were designated for housing construction; 4120 dunums were zoned in the north for housing (categories a and b). In the west 3140 dunums were planned. The overall plan of Greater Amman showed that

²⁸These are the families which cannot obtain the basic housing unit of 70 square metres built on a plot of land of 150 square metres in urban areas, and of 200 square metres in rural areas. Estimated cost of such houses is 7800 dinars (1986 prices) in Greater Amman area, 6100 dinars in other urban areas, and 5150 dinars in rural areas, without direct or indirect financial support.

²⁹See the basic background for preparing the five year development plan 1986-1990, for Ma'an and Balqa', Ministry of Planning 1985.

³⁰For more details see the overall development plan of Greater Amman- the final report.

even if the population in these settlements increased by 100%, the extra planned areas would remain empty, and that providing the necessary infrastructural services would be very costly.

Zoning problems. Among the wrong practices by local councils which violate planning regulations designating is allocating zoning areas a,b in areas which violate the regulations of these areas, such as the case of Irbid, where residential areas were allocated for a,b type even though they violate the regulations of these categories. This has led to many zoning infractions and high expenditures, prompting further violations of the planning regulations. Regulations for providing services and public facilities do not apply to such areas, which consequently suffer poor environmental and public health standards. Other violations are committed by residents of crowded camp houses who build a second floor without adhering to the relevant regulations.

2 EVALUATION OF THE HOUSING ENVIRONMENT

2.1 Housing Stock

Studying the general housing situation requires assessing housing units in terms of:

- Availability of services: potable water, electricity, heating, public sewerage system.
- Building areas, type of building.
- Number of rooms, families per house.
- Condition of the building: acceptable, upgradable, not upgradable.
- Satisfaction with the house and the neighbourhood.

Distribution of housing and services. The National Housing Strategy showed housing unit distribution according to availability of services indicated in Table 4 (Annex 1).

Table 4 indicates relatively healthy housing standards in most areas in 1987, in terms of availability of services, compared to those in most other developing countries. Approximately 89.2% of houses in the East Bank are linked to water networks, 94.4% have access to a sewerage network or separate lavatory, and 93% have electricity. Health standards of houses in Greater Amman and other urban areas are better than in the rural areas; the availability of a separate kitchen, for example, is 94.5%, 92.2% and 78.6%, respectively, and of a separate lavatory 84.6%, 74.7% and 55.2%, respectively.

Services in slums, squatter areas and camps. Slum and squatter areas near main cities and public roads have easier access to educational, health, and commercial services in neighbouring areas. Palestinian refugee camps include special areas for social activities and facilities. There are 196 schools for boys and girls in all camps in Jordan, in addition to administrative, social and health centres and clinics, commercial centres and social clubs³¹.

Available information at UNRWA, the Palestinian Affairs Dept., and the National Housing Strategy shows that the camps, which suffered from a lack of services when they were first established, have benefitted greatly from improvements like electricity, water and asphalted roads. However, public sewerage facilities are insufficient, and all services are less available in rural camps. Tables 5 and 6 (Annex 1) show water and sewerage access rates in camps, in slum and squatter housing sites, and for the East Bank as a whole.

The 1986 National Housing Survey showed that 95% of the houses in the Greater Amman area, 87% in other urban areas, and 80% in rural areas are in acceptable condition, whereas 1% of Amman houses, 9% in other urban areas, and 8% in rural areas are beyond repair or improvement; 4.4% of Amman houses, 4.7% in other urban areas, and 12.3% in rural areas need upgrading and improvement.

³¹For more information, see "Slum and Squatter Areas in the Hashemite Kingdom of Jordan", by Dr. Soheil Madanat and Hussam Akkawi (study submitted to HABITAT J Amman, Sept. 1987).

Satisfaction with house and neighbourhood. The National Housing Strategy added a new dimension to the assessment of the housing sector in Jordan—namely, the family's satisfaction with their house. The degree of satisfaction was highest in rural areas (93.6%) and lowest in Greater Amman (84.6%), as shown in Table 7 (Annex1).

- **Acceptable housing units:** these houses are connected to public water and sewerage networks or cesspools, and have walls and ceilings built of fixed permanent materials such as stone, reinforced cement or cement bricks.
- **Upgradable housing units:** these houses are not connected to public water and sewerage networks or cesspools.
- **Non-upgradable housing units:** these are marginal mobile houses and those built of clay or soft stone, as identified by the 1979 Population and Housing Census.

These standards do not apply to houses in camps, where other types of building materials prevail, such as concrete (38% of the houses), a mixture of bricks and corrugated metal sheets (55%), and only corrugated metal sheets (7%).

The reasons for lack of satisfaction with house or neighbourhood include location, social environment, shortage of services, and commercial or industrial noise or nuisances from shops, workshops, offices, cafes or nightclubs. This affects residents of high-density areas, especially in Greater Amman, with its concentration of economic and social activities.

2.2 Pressures Causing Misuse of Resources

Problems in the field of housing and environment are summarized as follows:

- Pressure on public facilities, service centres, and employment in large population pole centres such as Amman, Zarqa and Irbid.
- Construction expansion on lands not zoned for housing, especially agricultural lands.
- Slum and squatter settlements.

2.3 Main Obstacles to a Healthy Housing Environment

Like many other developing countries, Jordan faces many difficulties in maintaining a clean housing environment, such as:

- 1) Limited natural and financial resources available for the provision of services and basic public facilities for all houses.
- 2) Lack of integration of efforts of concerned agencies working in the housing sector, which hinders planning and negatively affects the housing environment, resulting in slum and squatter housing, marginal housing, and other settlements that violate public health laws, building codes and zoning regulations.
- 3) A discrepancy between the maps of the Lands and Survey Dept. and site maps issued by the local councils in cities and villages throughout the Kingdom. In addition, many legal violations by individuals and the imbalance in land planning for certain categories (a,b) have left many of these areas empty of construction.

3 STANDARDS AND SPECIFICATIONS FOR ENVIRONMENTALLY SUITABLE HOUSES

There is a reciprocal relationship between house and environment: the environment is affected by the house's existence, age, and length of occupation, while elements such as the climate and the nature of the surrounding soil affect the house. Any standards or specifications should take these elements into consideration if the main goal of building the house is the physical comfort of its inhabitants.

The house and the people living in it experience the impact of solar radiation, winds, humidity and rain, while the effects of the soil cover can be seen in climatic phenomena and

air pollution. Water bodies play a similarly important role in shaping local climate, which in turn affects the comfort of area residents. Water bodies and green areas contribute positively to environmental standards and human comfort, in terms of solar radiation and surrounding noise.

The effect of the house on the environment starts when the first plans are drawn up. Therefore, it is very important to establish controls, standards and specifications for the architect at the design stage, in order to meet the requirements of comfort and environmental safety. The environmental quality of the house can be maximized if the overall planning of the residential area also adheres to parallel controls, specifications and standards. The house is affected by the environment during the periods of construction and occupation, the second of which may last for a long time.

Although the second phase has the greatest effect on the environment, the first phase could also lead to environmental pollution and deterioration, and to changes in site topography and nature that may disturb the residents.

3.1 Aims of Standards

In view of the above, the suggested standards and specifications should emphasize the following:

- 1) Environmental study, planning and organization of cities should precede the design and construction of environmentally fit housing. These studies should take into account all factors relating to zoning regulations, empty spaces, the planning of land and roads, and other pertinent issues.
- 2) Architectural design should produce climatically suitable houses that provide comfort for the residents at the lowest possible cost. More important still is the use of clean energy, such as solar and wind energy, as substitutes for traditional energy sources in houses.
- 3) Rules, regulations and controls should be set for the construction phase, including provisions for the disposal of debris, and measures to be taken to maintain the surrounding environment during this phase. Regulations should also be established to maintain the character and well-being of the city, and not only of the building site.

3.2 Method of Implementation

To achieve all the above aims, it is recommended that:

- 1) All concerned in this field meet and propose recommendations regarding standards to be adopted.
- 2) In light of the results and recommendations of the working session, a committee of representatives from all concerned official parties should be formed to set appropriate standards and specifications, to be followed up by parties such as the Royal Scientific Society.

4 RECOMMENDED POLICIES IN THE FIELD OF HOUSING AND HABITAT

4.1 Habitat Policies

Habitat policies to preserve the environment can be achieved through provision of the following elements:

- Housing which provides safety and protection against natural elements, reflects the resident's individuality, and attends to his comfort.
- Basic facilities: service networks aimed at transferring people, commodities, energy and information in and out of the habitat.

• **Services:** all necessary community services such as education, health, culture, recreation and nutrition, to enable the habitat to function as a social body.

To achieve this goal, the government has formulated general housing policies, including measures and recommendations related to the housing environment. Studies concluded that existing environmental problems could be alleviated by promoting better human attitudes and practices.

4.2 Recommended Actions

1) Establish regulations to prevent the expansion of construction on lands allocated for other purposes. This can be achieved by defining optimal land use through comprehensive planning and preventing any change of land-use regulations unless absolutely necessary.

2) Adopt measures that would prevent changing land-use regulations within zoning plans.

3) Offer incentives and facilities to encourage the establishment of settlements on hills that are not suitable for agricultural purposes.

4) Provide small residential plots of land that facilitate access to environmentally suitable housing to prevent the development of slum and squatter settlements.

5) Refuse to issue licences for building on very steep land.

6) Encourage residential settlements around production sites (agriculture, industry) in order to relieve transportation pressures, to decrease accidents, and to enhance the workers' productivity and physical comfort.

7) Due to the interrelationship between the house and the environment, and the lack of housing standards and specifications, we recommend that a study be carried out to set environmentally suitable housing standards and specifications.

8) Prevent expansion of organizations unless public services and facilities for these areas are available.

9) Improve efficiency of monitoring and management staff to follow up violations in unzoned residential areas.

10) Preserve the architectural environment: respect the architectural style and texture of each area and the traditional building materials there. Planning and design basics applied in Greater Amman and the large cities in the Kingdom should not be applied to all areas in the country. Respect should be given to traditions and style of living in each area without demolishing the traditional buildings already existing there. Reasonable services should be provided in accordance with the building standards for rural and low-income housing areas.

11) Encourage and strengthen the greening of residential areas to reflect natural beauty and to preserve the cleanliness and purity of the area; activate afforestation processes wherever possible.

12) Develop and improve the residential status of random housing sites and in camps, grant a legal status to illegal residential settlements and provide them with all services.

13) Implement land-use organizational plans to prevent trespassing on government- or privately-owned residential lands.

14) Review existing zoned and unzoned areas and remove obstacles facing environmental health in those areas (open canals, dumping sites) in order to meet the above environmental requirements.

15) Encourage the implementation, by the local councils, of Article 64, Item 1 of the Organization of Cities, Villages and Buildings Law No. 79 of 1966, by taking measures to preserve the natural and human aspects of the environment, removing all that constitutes a health hazard whether licenced or not, and protect the available natural resources in their areas.

16) Implement Article 25, Item 1 of the Organization Law No. 79 of the year 1966, to review organizational plans every ten years for the purpose of updating to suit the prevailing conditions.

17) Carry out topographical and geological studies for areas to be zoned in order to prevent the expansion of residential areas into lands which are not fit for housing from those standpoints.

Consider institutional changes. 1) Link institutions working in the field of environment with the central institutional entities, represented currently by the Dept. of Environment, Ministry of Municipal and Rural Affairs and the Environment. 2) Form, as well, a higher council for environment that would be in charge of drawing up environmental policies on the national level which must be observed by all parties. 3) Establish a section in each environmental protection department to follow up the implementation of environmental protection laws.

5 INFORMATION SOURCES FOR HOUSING

5.1 Noteworthy Research and Technical Documents

Please refer to the successive development plans, the regional development plans, the sectoral development plans; especially labour and manpower, education, higher education, environment, housing, and municipal and rural affairs, which were prepared by the Ministry of Planning.

Reports of the National Strategy for Housing issued by the Shelter Unit - Ministry of Planning:

- Department of Statistics. Studies and Pamphlets.
- Greater Amman Municipality. Report of the Comprehensive Plan.
- Housing Corporation. Reports.
- IUCN-UNEP-WWF. (1991). *Caring for the Earth, A Strategy for Sustainable Living*. Gland, Switzerland and Nairobi, Kenya.
- Ministry of Planning Studies, especially these issued by: Productivity, Infrastructure and Manpower Unit departments.
- UN agencies. Reports.
- UNCHS, ESCWA, WHO. Reports.
- University of Jordan. Studies issued by the Population Studies and Geography departments.
- Urban Development Dept. Reports.

5.2 Noteworthy Maps

Zoning, structural and detailed maps prepared by the Ministry of Municipal and Rural Affairs and the Environment, Greater Amman Municipality, and other municipalities in the Kingdom:

- Maps prepared by the Royal Geographic Centre - Atlas of Jordan and other detailed maps.
- Maps prepared by the Geography Dept., University of Jordan.
- Maps prepared by the Lands and Survey Dept.
- Maps prepared by the Regional Planning Dept., Ministry of Planning.
- Primary maps issued by the Public Statistics Dept.

ANNEX 1 - HOUSING TABLES**Table 1 - East Bank Housing Stock**

Data for 1961 and 1979, with Estimates for 1986

<i>Distribution according to type</i>		<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
Traditional	Greater Amman	40,639	25.25	131,374	34.86	158,061	34.46
	Other Urban	23,066	14.33	84,543	22.44	170,939	37.27
	Rural	68,948	42.85	146,943	39.00	120,275	26.22
	Total	132,653	82.44	353,865	96.30	449,275	97.95
Marginal and mobile	Greater Amman	1,506	0.94	744	0.20	1,583	0.35
	Other Urban	1,038	0.65	1,228	0.32	3,369	0.72
	Rural	25,721	15.98	11,990	3.18	4,492	0.98
	Total	28,265	17.56	13,962	3.70	9,443	2.05
Total	Greater Amman	42,145	26.19	132,118	35.06	168,252	34.50
	Other Urban	24,104	14.98	85,771	22.76	175,682	38.30
	Rural	94,669	58.83	158,933	42.18	124,766	27.20
	Grand Total	190,618	100.00	376,822	100.00	458,700	100.00

Source: Ministry of Planning: National Housing Strategy, Technical Memorandum No. 7 of 1987.

Table 2 - Percentage of Rooms According to Occupancy Rate by Persons in Different Areas of Jordan - 1987 (%)

<i>No. of persons per room</i>	<i>Greater Amman</i>	<i>Other urban areas</i>	<i>Rural areas</i>	<i>East Bank</i>
1	38.7	34.6	32.8	35.5
2	28.3	30.4	29.4	29.4
3	16.5	15.9	17.6	16.6
4	7.2	10.3	10.1	9.2
	4.2	5.3	5.4	5.0

Source: National Housing Strategy, Technical Memorandum Number 7.

Table 3 – Occupancy Rates and Densities

<i>Density</i>	<i>Camps</i>	<i>Slum & squatter areas</i>	<i>East Bank</i>
Persons/room	4.0	3.2	2.7
Persons/dunum	55.5	46.0	-

Source: Results of National Housing Survey 1986, Shelter Unit, Ministry of Planning- Amman 1986.

Table 4 – % of Housing Units with Access to Services – East Bank, Greater Amman, Other Urban Areas, and Rural Areas, in 1987

<i>Area</i>	<i>Water network</i>	<i>Sewerage System</i>	<i>Electricity</i>	<i>Separate kitchen</i>	<i>Separate bathroom</i>	<i>Se-parate lavatory</i>
Greater Amman	95.2	98.6	98.0	94.5	84.6	97.4
Other urban areas	88.7	96.6	98.1	92.2	74.7	97.2
Rural areas	82.8	86.9	82.3	78.6	55.2	89.7
East Bank	89.2	94.4	93.0		72.4	95.0

Source: National Housing Strategy, Technical Memorandum No. 7.

Table 5 – Access to Water (% of total houses)

<i>Slum and squatter housing sites</i>	<i>Camps</i>	<i>East Bank</i>	<i>Method of Access</i>
95.3	66.7	89.2%	houses connected to the public network
-	13.4	2.3%	houses using public sources of water (public taps)
2.0	17.9	4.4%	houses using water from tanks
2.7	2.0	4.2%	houses using water from other sources

Table 6 – Access to Sewerage Systems (% of total houses)

<i>Slum and squatter housing sites</i>	<i>Camps</i>	<i>East Bank</i>	<i>Method of Access</i>
83.2	27.1	29.6%	houses connected to public sewerage network
14.1	63.4	64.8%	houses using cesspools
2.7	4.4	5.6%	houses using other means for waste disposal

Table 7 – Family's Satisfaction with House

	<i>Very satisfied</i>	<i>Satisfied</i>	<i>Not satisfied</i>	<i>Total</i>
Greater Amman	59.6	25.0	15.4	100%
Urban	56.4	31.3	12.3	100%
Rural	66.2	27.4	6.4	100%

Source: National Housing Strategy, Technical Memorandum No. 7.

Table 8 – Potable Water Sources

<i>Source</i>	<i>Greater Amman</i>	<i>Other urban areas</i>	<i>Rural areas</i>	<i>East Bank</i>	<i>East Bank 1979</i>
Public network	95.2	88.7	82.8	89.2	69.6
Public tap	-	4.7	2.0	2.3	7.0
Tank	2.6	6.0	4.6	4.4	13.2
Well	1.5	-	7.1	2.6	1.9
Stream	-	0.1	2.0	0.7	2.6
Others	0.7	0.4	1.5	0.9	5.6

Table 9 - Type of Sewage System Available in Houses

	<i>Greater Amman</i>	<i>Other urban areas</i>	<i>Rural areas</i>	<i>East Bank</i>	<i>East Bank 1979</i>
Public network	79.6	4.5	1.7	29.6	11.8
Cesspools	19.0	92.1	85.2	64.8	85.6
Others	0.7	1.7	0.8	1.1	0.4
Nothing	0.7	1.7	12.3	4.5	2.2

ANNEX 2 - INFORMATION ON WORKING GROUP

A-2.1 Current Membership of the Working Group w/List of Administration Appointments

Eng. Yousef Hiasat	Chairman, Director General of Housing Corporation
Mr. Husam Akkawi	Rapporteur, Urban Planner, Housing Planning Directorate, Housing Corp.
Mr. Ahmed Qudah	Jordan Armed Forces, Head of Manpower and Provision Div.
Mr. Isma'il Jarrah	Ministry of Interior, Follow-up and Inspection Dept.
Eng. Tayseer El-Ghoul	Ministry of Foreign Affairs, Head of Refugee Directorate, Palestinian Affairs Dept.
Eng. Khalil Dabbas	Ministry of Health and Social Development, Head of Environmental Engineering Sect., Environmental Health Dept.
Mr. Abdel Rahim Wreikat	Liaison Officer, Env. Researcher, Dept. of Environment, Min. of Municipal and Rural Affairs and the Environment
Dr. Hussein El-Khatib	Ministry of Planning, Head of Manpower Unit
Eng. Anas Qattan	Greater Amman Municipality, Mayor's Assistant for Planning Affairs
Dr. Kayed Abu Sabha	University of Jordan, Associate Professor Geography Dept., Faculty of Arts
Dr. Abdulla Zu'bi	Department of Statistics, Head of Population Section
Dr. Ali El-Ghoul	Jordan Society for the Control of Environmental Pollution
Eng. Mzahem Mheisen	Ministry of Municipal and Rural Affairs and the Environment, Director of Zoning Dept.
Mr. Abdel Karim Zyudi	Liaison Officer, Chemical Eng., Dept. of Environment, Ministry of Municipal and Rural Affairs and the Environment

Sub-Committees. Three sub-committees were formed:

1. Population
2. Housing and Environment (Habitat)
3. Environmental Health

A-2.2 Study Team

Mr. Husam Akkawi	Housing Corp., Committee Rapporteur
Mr. Walid Ya'qoub	Housing Corp.
Mr. Ahmad El Fandi	Housing Corp.
Mr. Jamal Abul Ajayiz	Housing Bank
Eng. Tayseer El Ghoul	Dept. of Palestinian Affairs
Gen. Ahmad Al-Qudah	Jordan Armed Forces
Eng. Wa'il Bakir	RSS
Eng. Muhammad Lafi	Irbid Municipality

A-2.3 Current List of On-Call Members

Dr. Hamzeh Anaqreh	Irbid Municipality, Director of Health Affairs
Eng. Muhammad Lafi	Irbid Municipality
Eng. Nayef Abu Aboud	Zarqa Municipality, Director of Zoning and Studies
Mr. Bassam Qaqish	Chairman, Aqaba Region Authority
Eng. Munther Saleh	REVCO
Mr. Jamal Abu El Ajayez	Housing Bank, Head of Studies and Research Unit
Eng. Mu'aweya Dabian	BAITUNA, General Manager

ANNEX 3 – INFORMATION ON KEY SOURCES OF SECTORAL KNOWLEDGE

A-3.1 Names and Affiliations of Informed Persons

Experts in Population

H.E. Dr. Bassam Saket	Former Minister of Agriculture
H.E. In'am Mufti	Noor Al Hussein Foundation
Dr. Muhammad Abdel	Secretary General of the National
Hadi El Akel	Population Committee, Queen Alia Fund
Dr. Fawzi Sahawneh	Head of Population Studies Dept. University of Jordan
Dr. Fathi Arouri	Faculty of Economics, University of Jordan
Dr. Ahamed Hammudeh	Population Studies Dept., University of Jordan
Dr. Mahmoud Abu Isa	U.N. Population Expert for the Ministry of Planning
Mr. Hussam Akkawi	Urban Planner, Housing Corp.
Mr. Ahamed El-Fandi	Head of Economic Studies Section, Housing Corp.
Mr. Walid Ya'qoub	Head of Social Studies, Housing Corp.

Experts in Housing

H.E. Eng. Hamdallah Nabulsi	Amman
H.E. Eng. Shafiq Zawaydeh	Amman
Eng. Yousef Hiasat	Director General, Housing Corp.
Dr. Suhail Mdanat	UN Expert UNCHS, Amman
Mr. Walid Ya'qub	Head of Social Studies Section, Housing Corp.
Mr. Ahmad El-Fandi	Housing Corp.
Mr. Hussam Akkawi	Housing Corp.
Mr. Tayseer El-Ghoul	Ministry of Foreign Affairs, Palestinian Affairs Dept.
Mr. Jamal Abul Ajayiz	Housing Bank
Mr. Wa'il Bakir	RSS
Mr. Ahmad Qudah	Jordan Armed Forces, Retired
Mr. Muhammad Lafi	Irbid Municipality
H.E. In'am Mufti	Noor Al Hussein Foundation

A-3.2 Names and Addresses of Government and NGOs

Ministries.

Planning, Municipal and Rural Affairs and the Environment, Interior, Health and Social Development, Education, Higher Education, Labour, Public Works and Housing, Information.

Government agencies and departments.

Housing Corporation, Urban Development Dept., Dept. of Statistics, Military Housing Corporation, Lands and Survey Dept., Greater Amman Municipality, Aqaba Region Authority, Jordan Valley Authority, Water Authority, Natural Resources Authority, Royal Scientific Society, Queen Alia Fund

for Social Welfare, Royal Society for the Conservation of Nature, Royal Jordanian Geographic Centre, Dept. of Palestinian Affairs, Municipal and Rural Councils (especially in Zarqa and Irbid).

Jordanian and Arab universities.

University of Jordan, Yarmouk University, Mu'ta University, University of Science and Technology, Higher Institute for Public Health, University of Alexandria.

Other agencies.

National committees and councils: National Population Committee, Higher Council for Zoning, Higher Council for Science and Technology.

Regional agencies: Housing and Construction Dept., Arab League, Arab Organization for Education, Culture and Science, Arab Labour Organization, General Secretariat of the Arab Co-operation Council, MEDA Saudi Arabia, Arab Cities Organization.

International agencies: UNRWA, WHO, UNESCO, ILO, IUCN, UNEP, UNCHS, Islamic Capitals Organization, UNICEF, FAO.

9 • Environmental Health³²

“The family and the community constitute a core issue in environmental development that unfortunately has not received the attention it truly merits. To this end, it is vital to maintain a mundane perspective towards issues that strike at the heart of family well-being and hygiene.

Provision of potable water, and garbage and sewage disposal, are pressing matters in rural and remote areas as well as in the suburbs of major Jordanian cities. The supply of these services must be tackled with vigour and resourcefulness in order to bring about tangible improvement in the quality of life for impoverished people.”

In'am Mufti, Director General
Noor Al Hussein Foundation

1 ENVIRONMENTAL HEALTH – CONCEPT AND ISSUES

1.1 Definition by W.H.O.

The World Health Organization defines environmental health as: *the control of all natural factors in man's environment which affect his life, welfare and continuous maintenance of his safety.* A committee of environmental health experts from WHO identified the issues included in the above definition as they relate to Jordan's case:

- Providing sufficient, safe water: the water policy in Jordan takes into account protecting the available resources, the quantity of water reserves in basins and surface water.
- Developing drainage systems for domestic waste and waste water: investigate treatment methods used in Jordan vis-a-vis their effectiveness and economic aspects of operation and maintenance, in order to adopt the best method. Selection of sites for transferring waste water and building treatment units must also be done with great care.
- Garbage collection and transfer and a healthful method for final disposal of wastes, including selection of suitable sites for this purpose.
- Environmental health in home and neighbourhood.
- Providing a healthful environment in workshops, factories, and public places.
- Controlling insects and other disease-transmitters.

1.2 Environmental Health Issues

a) Different areas of human activity often overlap: professional or industrial activities take place within residential areas; residential areas expand towards industrial areas; sites for industrial or residential activities are sometimes selected in environmentally unsuitable locales. Population settlements impinge on the environment as well.

b) Unsuitable work environment in factories and lack of basic health facilities and services; inadequate protection of the worker against accidents and occupational hazards.

c) Lack of regulations within the Greater Amman Municipality and MMRA&E controlling health standards for housing units and settlements of all categories.

³²Information in this chapter was prepared by the Population Committee, under the chairmanship of Eng. Yousef Hiasat, General Manager, Housing Corporation.

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d) There is danger of pollution in potable water, especially in the cities, due to the interrupted pumping in the network, which allows pollutants from outside to leak into the network.

e) Individual citizens must look for additional water sources because of general shortages and interrupted pumping. These other sources and distribution methods are not strictly controlled and may not be safe.

f) Incomplete legislation vis-a-vis licencing and conditions hampering regular control of the water network within single-family residences and multi-unit buildings, or other buildings such as hotels and restaurants. This applies to underground water reserves (wells), above-ground tanks and the piped-water network.

g) Increased pollutants (chemical and bacterial) in the water resources due to various reasons such as over-pumping of groundwater and leakage from cesspools or treatment plants close to water sources. Suitable health controls must be established to deal with this situation.

Fixed sources of pollution. There are waste-water treatment plants where large quantities of treated water are discharged. Effluent can be used for certain applications, but must be kept away from human settlements. Site selection for these plants is critically important and must take into consideration such factors as wind direction (to avoid diffusion of odour). With respect to factories, agencies must set conditions for industrial activities that guarantee the environmental safety of residential areas. Potential danger can arise from:

- Hazardous and chemical wastes, both solid and liquid: these can pose a threat at any point in the collecting, transferring, and discharging processes.
- Industrial solid wastes.
- Industrial liquid wastes: Jordanian specifications must reflect local conditions, and they must be enforced.

Mobile sources of pollution. Vehicles of all types are covered by this category. Additional scientific studies should be carried out by RSS to define areas of high concentration of various types of exhaust emissions. The Traffic Committee of the Ministry of Interior could then take the necessary measures to decrease air pollution hazards in some residential areas.

Other sources of environmental health problems. (i) Deterioration of water quality in streams and wells due to negligence by individuals and developers. (ii) Uncontrolled and excessive use of agricultural chemicals such as insecticides and fertilizers, which damages worker and consumer health, and which pollutes the environment (soil, water, air).

The Special Case of Northern Zarqa – An Observation

Lack of planning and neglect for environmental concerns has created serious impacts on the human environment of northern Zarqa. Incompatible land uses have developed on adjacent properties without proper planning controls or concern for emissions or waste handling. The high rate of industrial and residential growth has resulted in a degraded natural and human environment which is the worst in Jordan. The areas most impacted upon by industrial effluents and emissions are northern Zarqa (and the free zone), Um Sleih, Graisa, Zenia, Khirbet Samra, Mazra'a, Dhuleil, Khalidiya, Hashemiyeh and Sukneh.

According to practicing physicians in northern Zarqa, there is ongoing evidence of environmental health problems stemming from chronic air pollution in the area, along with contaminated water, and the buildup of solid waste. The area is surrounded by factories, as well as industrial plants (thermal power plant, oil refinery and an open air sewage treatment plant). Cattle, dairy and poultry farms are also located here. Cases of skin allergies, lung disease and other respiratory problems, dysentery, and typhoid are ascribed to pollution. Obnoxious odour adversely affects communities in the area, such as Dhuleil, depending on the wind direction. The incidence of mosquitoes, flies and other insects is high.

Towards an E.I.A. System for Jordan: the fact that the waste stabilization ponds of the largest waste treatment facility in Jordan were sited next to several communities reflects a system of decision-making which excluded the participation of local communities and public input over site selection. The Zarqa situation offers compelling evidence for the need to adopt a National Environmental Impact Assessment Procedure in Jordan, to ensure that future government decisions take environmental and human factors into account.

– John McEachern, IUCN

1.3 General Issues:

- a) The imbalance between the population growth rate and the provision of services has a negative impact on the surrounding environment and the efficiency of the service staff that cover this sector. It is necessary to conduct timely studies on the quality of waste water in terms of bacterial and chemical specifications, method of treatment and possibility of reusing it for different purposes.
- b) Decision-making is unduly influenced by social relations at the expense of technical evaluations.
- c) Lack of accurate, clear policies to deal with the environment and environmental health, and lack of workable mechanisms supported by legislation and carried out by trained persons, under scientific supervision and evaluation.
- d) The concerned agencies have various laws concerning the environment:
 - Laws and regulations are not always enforced or followed up, which is the case, for example, with industrial effluent specifications.
 - While some laws, regulations and directives address many aspects of environmental health, there are no regulations on treated domestic waste water.
 - Some laws, regulations and instructions do not clarify the required procedures.
 - Some of these laws (and regulations and directives) were not updated as required by changing environmental conditions and scientific evaluation in the concerned fields.
- e) There is no mechanism to allow individuals, groups and agencies to participate in drawing up environmental plans (environmental health), and taking decisions which affect their lives, interests, and work. People have great interest in being a part of implementing these plans; many of their reactions and complaints could be dealt with from the start, to bring about changes that suit local communities and serve them effectively.
- f) Absence of team spirit in activities carried out by the different agencies hampers co-operation and co-ordination; efforts, resources, and human energies are wasted. The formula adopted to solve this problem, namely setting up committees, has not proven

successful; their work mechanisms are inefficient, and the random selection of their members has made them unable to fulfil the tasks assigned to them.

g) Current programmes and projects in the field of environmental health suffer a general weakness caused by various factors:

- Shortage of funding necessary for implementation.
- Qualitative and quantitative inadequacy of the technical staff assigned to implement programmes and projects, caused in part by lack of human resource training policies.
- Lack of the necessary administrative support to manage programmes and projects efficiently.

h) Investigate the extent of livestock, poultry and domestic animals being raised in residential areas and the health implications of this practice.

2 RESOURCES IN ENVIRONMENTAL HEALTH

2.1 Responsible Agencies

Agency	Relevant Sub-agencies
Ministry of Health; Public Health Law No. 21 of 1971	Environmental Health Section; Food Section; Health Education Section
Ministry of Municipal, Rural Affairs & the Environment; Organization Law No. 79 of 1966	Department of Environment
Ministry of Water and Irrigation; Law No. 18 of 1988	Water Authority, Jordan Valley Authority; Lab Dept.; Central Operations Dept.; Rural Development Dept.
Municipality of Greater Amman, Regulation No. 18 of 1988	Community Health Dept.; Public Cleaning Section; Lab and Health Services Section; Insect and Rodent Control
Ministry of Agriculture	Licencing Committee of Insecticides; Lab for Insecticide Residues; National Centre for Agricultural Research
Ministry of Interior	Higher Committee for Public Safety; Public Safety Section
Ministry of Industry & Trade	Specifications & Measurements Dept.; Lab Dept.
Ministry of Energy & Mineral Resources	Public Safety Section; Radiation Monitoring Section
Ministry of Education & Higher Education	Curricula Section; Environmental Health Education; Graduate Studies Section; Community College Section
Ministry of Labour	Vocational Training Institute; Vocational Health & Safety Institute
Ministry of Transport	Meteorological Dept.
Royal Scientific Society	Environmental Research Centre
Royal Society for the Conservation of Nature	
Jordanian Society for the Control of Environmental Pollution	
University of Jordan	Water Research and Study Centre
Royal Geographic Centre	
Queen Alia Jordan Social Welfare Fund	National Population Committee

There has developed over the years a degree of duplication in some of the services provided by the above agencies. To achieve more effective environmental management, it is

necessary to unify measurements and standards and establish a relationship between all these agencies that would avoid duplication of activities or use of different standards.

2.2 Current Legislation

The following are some of the most important laws and regulations relating to environmental health.

- Health Law No. 21 of 1971 and all its amendments and regulations, such as the defense order controlling and defining uses of waste water.
- Agriculture Law No. 20 of 1973.
- Water Authority Law No. 18 of 1988.
- Municipalities Organization Law No. 79 of 1966.
- Regulation No. 61 and No. 67 of 1979, Regulation of Buildings and Zoning in Amman.
- Regulation No. 79 of 1986, City and Village Buildings and Zoning Regulations.

3 PROPOSED ACTIONS TO MANAGE RESOURCES

- Adopt educational and training policies that take characteristics of local communities and environmental requirements into account.
- Draw up general policies for environmental health activities; assign tasks; define specific goals against which performance can be evaluated.
- The establishment of a strong body to monitor environmental health activities is vital; such a body would also determine how to co-ordinate relations among different departments and would find effective work mechanisms for all programmes. All such activities should be subject to an annual evaluation to measure achievements against goals.
- Scientifically address the health issue of raising farm animals within residential areas by: (i) adopting pollution-prevention programmes; (ii) instituting and enforcing an EIA procedure; (iii) creating public awareness of environmental health; (iv) involving local councils in implementing environmental health projects in their communities; and (v) drawing upon international agencies (e.g., WHO) for technical and financial assistance.

4 OBSTACLES TO BE OVERCOME

4.1 At the Sector-Level

- Lack of comprehensive environmental legislation.
- Lack of necessary funding to implement environmental health programmes.
- Weakness of scientific studies.
- Duplication of efforts and lack of co-ordination between the different agencies.
- Shortage of specialists in the field of environmental health.
- Weakness of environmental and health education; lack of positive interaction between the citizen and the environment.
- Shortage of training programmes that would enable workers in environmental health programmes to deliver environmental services.

4.2 Problems within Agencies

Department of Environment

- Environmental legislation formulated, but not yet approved.
- Lack of sufficient financial allocations.
- Insufficient specialized technical staff.
- The department's lack of independent authority.

University of Jordan, Water Research and Study Centre

- Lack of some equipment; local shortage of spare parts.
- Some chemicals unavailable locally.

Ministry of Health

- Duplication of agencies working in the same field.
- Shortage of vehicles for field visits.
- Insufficient financial and technical resources for in-house laboratory work.
- Technical staff do not have the necessary authority to implement the suitable recommendations, and are constrained by bureaucracy.
- Assignment of some employees to positions based on social connections instead of their technical qualifications.

Royal Scientific Society, Environmental Research Centre

- Lack of necessary funding for environmental projects.
- Shortage of specialists in environmental fields.
- Low environmental awareness on the part of the public.

Municipality of Greater Amman

- Lack of financial support for certain projects in the field of industrial and hazardous waste disposal.
- Information not exchanged among the concerned agencies working in the field of environment and solid wastes.
- No one agency is solely responsible for managing solid wastes in Jordan or carrying out research relating to such issues.

5 INFORMATION SOURCES FOR ENVIRONMENTAL HEALTH

5.1 Noteworthy Research and Technical Documents

- Ahmad, Abdullah A. (1989). "Accident Prevention and Occupational Safety and Health" (Chapter 9) in *Jordan Environmental Profile-Status and Abatement*. Amman, Jordan.
- Council of Development. Seven-part Programme of the Jordanian Development Plan.
- Documents of the National Conference on Drinking Water, 1983.
- Effect of Surface Water on Development Projects in the Jordan Valley Authority Environment.
- Institute of Public Safety and the Ministry of Health.
- IUCN-UNEP-WWF. (1991). *Caring for the Earth, A Strategy for Sustainable Living*. Gland, Switzerland and Nairobi, Kenya.
- Lead Pollution in the Battery Factory.
- Ministry of Health. Air Pollution Caused by Vehicles in Amman.
- Ministry of Health. Annual Report of Water Samples.
- Ministry of Health. Evaluation Study of the Functioning Efficiency of the Treatment Plant at Khirbet Samra.
- Ministry of Health. Monitoring Air Pollution in the Abdali Area.
- Ministry of Health. The Effect of the Cement Factory on Air Quality.
- Ministry of Municipal, Rural Affairs & the Environment. (1989). "Human Settlement and the Environment" (pages 257-272) in *State of the Environment*, Arabic. Edited by Sufyan Tell and Yaser Sara. Amman, Jordan.
- Ministry of Planning. The Three- and Five-Year Development Plans.
- Natural Resource Authority with a Technical Team from the German Government. The National Water Strategy in Jordan, second volume (in English).
- Royal Scientific Society. Monitoring Air Pollution in Amman, Final Report.
- RSS and Jordan Valley Authority. Report on King Talal Dam.
- RSS and MMRA&E. The National Project for Studying Water Quality in Jordan - 3rd Annual Report.

- RSS. A Study on Khirbet Samra Treatment Plant Water Reaching Jerash.
- RSS. Environmental Research Centre. Surface Water Quality and Proposed Protection Methods in Jordan.
- RSS. First Regional Study Workshop on Air Pollution.
- Section of Sciences and Technology. (1980). Report on Environment in Jordan (in English).
- UNEP. Environmental Perspective Until the Year 2000 and Beyond.
- UNEP. Monitoring and Control of Air Pollution in Jordan.
- University of Jordan. Water Pollution Seminar, Water Research and Study Centre.

5.2 Recommended Site Visits for a Rapid Appraisal

Several field sites may be visited by investigators wishing to make a rapid appraisal of the environmental conditions which are discussed in this chapter. Note, however, that these sites have not been selected comprehensively, and other sites may also warrant visitation:

Residential areas

- The Ghor: Kafrin area, Rama, Karama, Wadi Yabis, Ghor Safi, and other areas which can be identified in co-operation with the Jordan Valley Authority.
- Densely populated areas such as Baq'a camp, Hitteen camp.
- Areas adversely impacted by H₂S: North Zarqa, Hashemiyeh and Sukhna.
- Developed residential areas constructed by the Urban Development Dept.
- Residential areas which need development.
- Residential areas in the northeastern *Badia*.

Solid Waste Disposal Sites. Amman, Zarqa highway, Russeifa, Akider (Irbid district).

Other Sites. Baq'a Basin, Wadi Mashash Basin, Disi Basin, Azraq Basin.

Factories

- Phosphate-loading plant
- Cement factory
- Chemical factories
- Tanneries

Sewage treatment plants. Salt, Zarqa, Ain Ghazal, Baq'a, Khirbet Samra.

ANNEX 1 – STRATEGY WORKING GROUP AND ENVIRONMENTAL HEALTH ORGANIZATIONS

1.1 Study Team:

Eng. Khalil Dabbas	Ministry of Health, Committee Rapporteur
Dr. Fuad El Ayed	Ministry of Health
Mr. Abdel Rahim Wureikat	Ministry of Municipal, Rural Affairs & the Environment
Eng. Nazih Shalbak	UNRWA

1.2 List of Jordanian Agencies Concerned with Environmental Health

Environmental Health Activities Centre/WHO
 Higher Council for Science and Technology
 Jordanian Society for the Control of Environmental Pollution
 Ministry of Agriculture
 Ministry of Education
 Ministry of Higher Education

Ministry of Energy and Mineral Resources
Ministry of Health
Ministry of Industry and Trade
Ministry of Interior
Ministry of Labour
Ministry of Municipal, Rural Affairs & the Environment
Ministry of Transport
Ministry of Water and Irrigation
Municipality of Greater Amman
Noor Al Hussein Foundation
Queen Alia Jordan Social Welfare Fund
Royal Geographic Centre
Royal Scientific Society
Royal Society for the Conservation of Nature
University of Jordan

ANNEX 2 – KEY INFORMATION SOURCES

A-2.1 Experts in Environmental Health

H.E. Mr. Anis Mouasher	Chairman, Royal Society for the Conservation of Nature
H.E. In'am Mufti	Director General, Noor Al Hussein Foundation
Eng. Nazih Shalbak	UNRWA, Amman
Eng. Muh. Hussein Dajani	Environmental Consultant, Ministry of Health
Dr. Fahmi Sharqawi	Head of Environmental Health Section, Higher Institute of Public Health, Alexandria University
Eng. Khalil Dabbas	Ministry of Health, Committee Rapporteur
Dr. Fuad El Ayed	Ministry of Health
Mr. Abdel Rahim Wureikat	Ministry of Municipal, Rural Affairs & the Environment
Dr. Murad J. Bino	Dir., Environmental Research Centre, RSS
Eng. Subhi Ramadan	Section Head, Water and Soil Control, RSS
Dr. Elias Salameh	Dir., Water Research and Study Centre, University of Jordan
Eng. Iyad Abu Maghli	Asst. Researcher, Water Research and Study Centre, University of Jordan
Dr. Abdel Aziz Weshah	Sec. General, Jordan Valley Authority, Ministry of Water and Irrigation
Dr. Kamel Al Qaisi	Sec. General, Jordanian Society for the Control of Environmental Pollution
Dr. Ihsan Shokaji	University of Jordan
Dr. Khaled Shami	University of Jordan, Faculty of Medicine, Community Health
Dr. Atallah Rabi'	Jordan University of Science and Technology, Public Health Faculty
Dr. Younis Hijazi	Jordan University of Science and Technology
Mr. Mahmoud Abdulla	UNRWA, Jordan
Dr. Hussein Zaki	Assistant for Health Affairs to Mayor of Amman
Dr. Mohammad Nofal	Dept. of Community Health
Dr. Hasan El Baroudi	Co-ordinator, Environmental Health Centre, WHO
Dr. Fahmi Sharqawi	Head, Environmental Health Section, Higher Institute for Public Health, University of Alexandria
Dr. Hasan Mitwalli	Higher Institute for Public Health, University of Alexandria
Dr. Ahmad Husam Eddin	Higher Institute for Public Health, University of Alexandria

10 • Atmosphere & Air Quality³³

This chapter discusses sources of atmospheric pollution in Jordan, and their environmental effects. The agencies responsible for measuring pollution levels are identified, as is the expertise available in this field. Finally, recommendations and actions to keep pollution at the permissible limits are suggested, along with legislative initiatives.

1 POLLUTANTS IN JORDAN

1.1 Primary Importance

TSP. These are the solid and liquid suspended particulates in the air with a diameter of less than 100 microns. In addition to naturally occurring desert dust, sources of this pollutant include: transportation, fuel combustion from stationary sources, industries, brush and grass fires, and dust from unpaved roads.

Prevention and control of dust pollution are achieved by separating and collecting dust at its source, using methods such as settling chambers, cyclones, wet scrubbers, electrostatic precipitators and bag filters.

SO₂. This pollutant results from the combustion of fuel containing sulphur. The major sources of this gaseous pollutant are power plants, vehicles and melting ovens. Emissions of this gas are controlled by absorption, adsorption and catalytic conversion.

H₂S. This results from refining operations of hydrocarbons containing sulphur, and during anaerobic decay of organic matter in treatment plants and sewerage systems. This pollutant can be controlled during refining with special equipment.

CO. This pollutant results from incomplete combustion in vehicle engines, especially gasoline engines.

Hydrocarbons. Sources of these materials are petroleum refineries, vehicles, paint industries and tanneries.

NO_x. The gases referred to here are NO and NO₂. Their major sources are fuel combustion from stationary plants and vehicle exhaust.

Agricultural insecticides. These include various harmful organic and chemical materials if released into the atmosphere.

Pb. Lead is a heavy toxic metal used in many industries, including those producing batteries and base paints, and in upgrading petrol octane. The main source of lead emissions is vehicle exhaust, in countries using leaded gasoline.

1.2 Other Pollutants

Noise. Noise is considered an environmental pollutant that has a harmful effect on man. The ear is injured if it is exposed to a noise level of 90 dB for 8 hours. The committee discussed this issue and considered it unrelated directly to its scope. It was also evident that none of the eight NES committees has addressed this issue.

Odour. Odour is one of the most complex air pollution problems and it is classified among non-criteria pollutants. Man's nose is considered the best device for measuring odour, and a team of 2-15 trained experts is normally chosen to measure odour. Volatility and vapour pressure are the most important properties of the materials causing odour. Long exposure to

³³Information in this chapter was prepared by the Air Committee, under the chairmanship of Dr. Abdullah Toukan, Secretary General, Higher Council of Science & Technology.

a fixed, concentrated odour may cause a person to lose the correct sense of it. Many people classify odours into 5 or 6 types which can overlap: spicy, flowery, fruity, resinous and burnt.

Odour is controlled by ventilation, the removal of odour-causing material, absorption, adsorption, oxidation, or by chemically changing strong odour-releasing materials into less- or non-odour-releasing materials. The technique of inserting a strong pleasing odour to mask a bad odour may also be adopted.

Sources of bad odours in Jordan:

- Khirbet Samra treatment plant - Hashemiyeh.
- Jerash sewage treatment plant.
- Salt sewage treatment plant.
- Abu Nuseir sewage treatment plant and all other waste water treatment plants in the country.
- Industrial plants, such as the Jordanian Tannery Co., the JPRC oil refinery, Hussein Thermal Power Station, the yeast factory, and the industrial waste water treatment facilities in those plants.
- Slaughter houses
- Waste disposal sites
- Vehicle exhaust and combustion emissions, especially in restricted areas with heavy traffic (such as downtown Amman).

1.3 Standard Air Criteria and Specifications

There are no official standards criteria and specifications or maximum acceptable levels for air pollutants in Jordan. Therefore, the agencies involved in environmental affairs use international standards, and it is very important that the concerned agencies in Jordan, in co-operation with international agencies, should establish national specifications for air pollutants, as has been done in the field of water treatment. Examples of air criteria and specifications for selected urban areas are listed in tables 1 & 2, Annex 1.

2 AIR POLLUTION SOURCES IN JORDAN

2.1 Current Sources of Air Pollution

Stationary Sources. The most important stationary sources of pollution and the main contaminants emitted by them are listed in Table 3, Annex 1.

There are also some small- and medium-sized factories in the environs of Amman, Irbid, Salt and Karak. They all contribute to localized air pollution.

Mobile Sources. There are vehicles of all kinds. The number of registered vehicles in Jordan is estimated at 250,000 of those using gasoline and diesel oil. In 1987, 435 million litres of gasoline, 888 million litres of diesel oil and 176 million litres of kerosene were consumed. Civil and military airplanes: at Queen Alia airport, 1700 aircraft take off and land monthly. Ships in Aqaba port. Trains (chiefly serving the mining industry).

The above sources cause the emission of the following pollutants: Pb, NO_x, CO, CO₂, SO₂ and the photo-chemical reactions resulting in the formation of ozone.

Natural Sources. The most important of these are sand and dust storms. Jordan is exposed to Khamasini conditions in the spring as a result of Khamasini depressions coming across the North African coast from the southern Atlas Mountains in Algeria. Statistics at the Meteorological Department indicate that 5-6 depressions occur annually, and that the quantities of dust resulting from them reach 1.8 million tons/yr. In Amman those quantities are estimated at 360 tons/yr. The turbidity factor doubles during Khamasini conditions and

direct solar radiation decreases from $300\text{J}/\text{cm}^2/\text{hr}$ to $220\text{J}/\text{cm}^2/\text{hr}$, whereas diffused radiation increases from $60\text{J}/\text{cm}^2/\text{hr}$ to $114\text{J}/\text{cm}^2/\text{hr}$.

Cosmic rays and natural radioactive isotopes in air particles are other natural sources of atmospheric pollution.

2.2 Agencies Involved in Monitoring Air Quality in Jordan

Meteorological Department. Established in 1952, the department has been measuring and analyzing various climatic parameters at its stations around the country, including:

- Temperature, humidity, clouds, air pressure, wind speed and direction, visibility and precipitation.
- Atmospheric phenomena such as sandstorms, thunderstorms and fog.
- Turbidity levels and quantities of direct and diffused solar radiation.
- Quantities of suspended dust in the atmosphere.
- Rain-water.

The department has a record of all climatic elements measured in Amman since 1923.

The DOE. Department of Environment (Ministry of Municipal and Rural Affairs and the Environment). The activities carried out by the Air Protection Section in the department are to:

- Monitor industries and activities that cause air pollution, and impose restrictions to protect air quality.
- Study the environmental impact of newly proposed industrial activities or plants.
- Prepare contingency plans for air pollution, and define executive measures.
- Prepare legislation concerning air protection.
- Help select sites of industries which emit air pollutants.
- Select domestic and industrial waste disposal sites and study treatment of domestic and industrial wastes.

Royal Scientific Society. The Air and Hazardous Chemicals Division of the Environmental Research Centre conducts studies and research concerning open air ambient air pollutants, as well as pollutants found within the work environment (hospitals and factories) and in home environments. The division also contributes to the preparation of standard specifications for air pollutants. Recently released studies of public interest include:

- *Air Pollution Monitoring in Amman.* This study for the period 1986-1990 produced measurements of TSP, NO_x , CO and SO_2 . The study revealed high levels of TSP in the air, especially in downtown Amman, where they exceed most international health standards. SO_2 measurements show that the annual mean in downtown Amman also exceeds permissible international health limits. The daily mean, however, was low in general. CO exceeds the WHO standards for almost one-quarter of the year. The study also showed low levels of NO_x , with only some levels in excess of international standards. During 1989, the conditions in downtown Amman were sufficient to cause photo-chemical smog. However, pollution levels in other parts of Amman were significantly lower.

The results of the study indicated that there is a need to implement more pollution monitoring projects in other areas of the country, especially in Awajan and Zarqa, in addition to continuing pollution monitoring in downtown Amman.

- *Hydrogen Sulphide Pollution in Populated Areas of Hashimiya Township (1989).* This one year study was carried out at Hashimiya, where two main sources of H_2S emissions are situated. These are the Jordan Petroleum Refinery and the Khirbet Samra treatment plant. The study revealed levels exceeding international standards for H_2S , accompanied by obnoxious odours in the area. It also showed higher gas concentrations at night and in winter. The study indicated the need to conduct extensive research in this area, as it is expected to be subject to additional pollutants from the Hussein Thermal Power Plant. Residents may be affected by more than one pollutant at the same time, which may have harmful health effects.

• *Air Pollution in Aqaba by Phosphate Dust during Loading (1989-1990).* The results of this study indicate a level of suspended dust in the air in Aqaba exceeding the limits of international health standards. The transport, loading and unloading of phosphate contribute significantly to the dust level in the city.

New Initiatives to Reduce Dust

Jordan Phosphate Mines Co. and Phosphate Fines Recovery

Jordan Phosphate Mines Co. (JPMC) has taken several steps to reduce phosphate dust at the mines and at the port of Aqaba, not only in terms of protecting the environment but also for the recovery of a valuable resource amounting to millions of U.S. Dollars of phosphate fines. Previously the phosphate dust is lost to the atmosphere or to the surrounding area, thus creating air pollution nuisance.

The phosphate dust air pollution control measures taken so far, are as follows:

- Monitoring of dust levels of phosphate handling and load-out facilities at the port of Aqaba from June 1989 to May 1990. This study was conducted by the Royal scientific society and financed by JPMC.
- Installation of an improvised phosphate dust recovery system at the dryers in the mines. The estimated amount of phosphate fines to be recovered is less than half a million tons per year.
- Erection of a single super phosphate plant at El-Abyad mine (which is on stream now) to utilize in part the recovered phosphate fines.
- Modification of the feeding system at the Fertilizer Complex in Aqaba to utilize the phosphate fines recovered and use it as a feed during the manufacture of phosphoric acid.
- Constructing special fine phosphate pneumatic convey system with silo-truck loadout facilities, with minimal emission during its transportation to Aqaba and its discharge.
- At the port of Aqaba a choke feeders system is to be installed at the three shiploaders (responsible for the visible emission) in Aqaba Port. Tender documents for the choke feeders system have been finalized by a formed joint technical committees of JPMC and Aqaba Port Corporation (APC). The implementation of the system will be the responsibility of Aqaba Port Corporation, while financing will be arranged through Ministry of Planning.

– Mustafa Salma, Jordan Phosphate Mines Co.

Ministry of Energy & Mineral Resources. The ministry has a network of environmental radiation-monitoring stations which measure the background level of natural radiation. There is also an early warning network to measure Gamma radiation levels in the air, and to indicate any change due to local or external radiation accidents.

The results of continuous TLD measurements made since 1987 show that the radiation dose to which the Jordanian citizen may be exposed, as a result of external exposure to Gamma rays of cosmic or terrestrial origin, is 0.23 - 0.76 msv/yr, which is within internationally permitted limits.

Ministry of Health. This ministry is responsible for all health affairs in the Kingdom, according to Public Health Law No. 21 of 1971. The main tasks of the ministry, which are carried out by its Environmental Health Division and the health departments, are:

- To monitor air pollution sources, whether fixed (like factories and disposal sites) or mobile (like vehicles).
- To measure air pollutants in factories and in external environments.

Vocational Safety & Health Institute. The institute carries out measurements of air pollutants—especially in work environments—conducts specialized field studies, and gives advice and guidance to public institutions regarding the control of pollutant concentration levels. The institute's staff use a mobile lab unit equipped with environmental measuring equipment for taking samples to measure concentrations of dust, gases, vapours and radioactive materials in the work environment.

The Armed Forces. The armed forces have equipment available at their main workshops to measure and control pollutants emitted by those workshops. The chemical war group has equipment to measure toxic military gases in emergencies.

Jordan Phosphate Mines Co. The company carries out measurements of the following pollutants in the Aqaba industrial fertilizer compound: F_1 , sulphuric acid mist, P_2O_5 and SO_3 . The company works with the RSS to measure phosphate dust at Aqaba port.

The JPRC oil refinery. On a weekly basis, the refinery measures concentrations of the following gases in its environment: CO_2 , CO, H_2S and SO_2 .

Jordan Cement Factories Co. The cement company has acquired special equipment to measure dust emitted from chimneys, follow up dust precipitators' performance, analyze the pertinent reports and follow up developments in dust pollution.

2.3 Main Issues According to Priority

1) Zarqa Basin area, including the following areas:

a) Hashimiya: located northeast of Zarqa, close to the Jordan Petroleum Refinery, the Hussein Thermal Power Station, and the Khirbet Samra treatment plant. These facilities are considered main sources of the following pollutants: SO_2 , H_2S , CO, Hydrocarbons, TSP and NO_x .

b) Russeifa: phosphate dusts (TSP).

c) Zarqa: this city is the country's second largest in terms of urban population and number of vehicles. Different industrial enterprises within Zarqa subject it to most of the same pollutants which occur in the Hashimiya area.

2) Aqaba: this is Jordan's only marine port, through which most of the country's imports and exports are transhipped. It is also the most important tourist area in the country, serving domestic and international markets. Aqaba suffers from dust pollution as a by-product of the transport, loading and unloading of phosphate and cement.

3) Fuheis: located northwest of Amman, it is affected by dust emitted by the cement factory.

4) Downtown Amman: this area is affected by traffic jams throughout the year. It is surrounded by mountains on all sides, which prevents the dispersion of pollutants from vehicle exhaust. Studies carried out in the area indicate a high level of these pollutants: TSP, SO_2 , CO and NO_x .

5) Occurrence of natural dust: Jordan is subject to sand and dust storms, specially during the Khamasini season in the spring. Khamasini depressions, originating in North Africa, cross into Jordan carrying dust and sand, which reduce direct solar radiation.

6) Harmful practices exacerbating the decline in air quality such as burning used tyres and domestic and industrial wastes, the handling of construction wastes, and the presence of Pb foundries inside cities.

3 SUMMARY CAUSES OF AIR POLLUTION

a) Lack of comprehensive and effective laws and regulations for the control of air pollution and the protection of clean air.

b) Rapid and continuous rise in population, and the resulting increase in the number of vehicles of all kinds, and the increase in energy consumption in the Kingdom.

c) Rapid industrialization in the late seventies and the early eighties, which led to the overlap of industrial and craft areas with residential and commercial areas.

d) Some harmful practices, such as burning rubber tyres, and the disposal of domestic and industrial wastes.

e) Unpaved roads throughout Jordan.

f) Depletion of small green areas in some regions, and encroaching upon agricultural lands.

- g) Insufficient industrial and professional compounds that serve all parts of the country.
- h) The growth of the construction sector, and the accompanying increase in the number of quarries and the transport of building materials and construction wastes.
 - i) Irregular maintenance of static and mobile fuel-burning equipment.
 - j) Fuel quality in terms of the level of toxic materials such as sulphur and lead.
 - k) Transport, shipping and export of raw materials such as phosphate and cement.
 - l) Natural factors related to an area's climate.
 - m) Lack of environmental impact assessments for past development projects.
 - n) The use of old types of technology which do not take environmental considerations into account.
 - o) Low level of environmental awareness.
- p) Duplication in the control and monitoring of air pollution by official and semi-official agencies, and weak co-ordination among them.
- q) Shortage of financial resources and technical capabilities in the areas of development activities, research, studies and the monitoring needed for pollution control.

4 RECOMMENDED ACTIONS TO RESOLVE AIR QUALITY PROBLEMS

4.1 Strategy Initiatives

Following is a prioritized list of important issues which must be addressed

Issue & Location	Suggested Actions	Objectives of the Action	Dates	Responsible Agencies
Control air pollution in Hashimiya area	Establish a monitoring and detection network for priority pollutants stated in item 3.4.1.a	Define level of concentration of pollutants in the air and sources of emissions.	1992, 3-5 years	Department of Environment, Ministry of Health, Meteorological Department, RSS
	Evaluate negative health impacts on population.	Design specifications for air pollutants.	1992	Ministry of Health
	Cooperate with international agencies to help set Jordanian national specifications for main air pollutants.	Define national specifications.	one year	Department of Environment, Ministry of Health
	Formulate legislation, regulations and directives.	Oblige sources of pollution to adhere to legal procedures.	one year	Department of Environment
Control phosphate dust pollution in Russeifa	Continue monitoring after the project is completed.	Ensure adherence to specifications, regulations and directives.	1996	Department of Environment, Ministry of Health, Meteorological Department, RSS
	Establish networks to monitor and detect phosphate dust in Russeifa from several fixed stations.	Define level of phosphate dust concentration in Russeifa.	1992-1995	Department of Environment, Ministry of Health, Meteorological Department, RSS
	Evaluate health impact on population.	Set specifications for dust in Russeifa.	-	Ministry of Health
	Submit the results of the study and monitoring process to concerned parties for decision-making.	Control dust pollution in the city.	1995	Department of Environment, Ministry of Health, RSS
	Continue monitoring in the city through fixed stations.	Ensure adherence to regulations regarding the control of pollution.	1995	Department of Environment, Ministry of Health, Meteorological Department, RSS
	Establish monitoring network composed of two fixed stations in Zarqa city to monitor main air pollutants listed in item 3.4.1.a.	Define level of concentration of said air pollutants.	1992-1995	Department of Environment, Ministry of Health, Meteorological Department, RSS
Zarqa city	Evaluate health impacts on population.	Set air pollutant specifications.	1992 - 1995	Ministry of Health
	Co-operate with international agencies to decide upon national specifications for these pollutants.	Set national specifications.	1995 - 1996	Department of Environment, Ministry of Health
	Formulate regulations, legislation and directives to control pollution.	Oblige pollution sources to adhere to legal procedures.	1995 - 1996	Department of Environment
	Continue monitoring after the end of the project.	Ensure adherence to specifications, regulations and directives.	1996	Department of Environment, Ministry of Health, Meteorological Department, RSS

Strategy Initiatives...Continued				
Following is a prioritized list of important issues which must be addressed				
Issue & Location	Suggested Actions	Objectives of the Action	Dates	Responsible Agencies
Aqaba city	Establish a network, composed of fixed stations in the city, to monitor and detect dust, especially phosphate and cement dust.	Define level of dust concentration in Aqaba (phosphate and cement).	1992 - 1995	Department of Environment, Ministry of Health, Meteorological Department, RSS
	Evaluate health impacts on population.	Set suitable specifications for dust in Aqaba.	1992 - 1995	Ministry of Health
	Submit results of the study and monitoring process to the concerned agencies so that specifications for dust control in Aqaba may be established.	Control dust pollution in the city.	1995	Department of Environment, Ministry of Health, RSS
	Continue the monitoring process in the city through 3 fixed stations.	Ensure adherence to regulations and specifications to control pollution.	1995	Ministry of Health, Department of Environment, Meteorological Department, RSS
Control air pollution by cement dust in Fuheis	Establish a network, composed of several fixed stations, to monitor and detect cement dust in the city.	Define level of cement dust concentration in the air.	1992 - 1995	Department of Environment, Ministry of Health, Meteorological Department, RSS
	Evaluate health impacts on the population.	Set dust specifications in Fuheis.	1992-1995	Ministry of Health
	Formulate regulations and directives defining the level of emitted dust from the cement factory chimneys.	Control the level of pollution.	1995	Ministry of Health, Department of Environment
	Continue monitoring in at least one station.	Ensure adherence to regulations and instructions to be issued.	1995	Department of Environment, RSS
	Update, expand and continue monitoring activity at the current station.	Continue to monitor this area, due to high level of pollution.	1992	Department of Environment, Ministry of Health, Meteorological Department, RSS
Downtown Amman	Evaluate health impacts on the population.	Set standards for pollutants in Amman.	1992	Ministry of Health
	Make necessary recommendations to concerned agencies to control pollution in the downtown area.	Control pollution in the area.	1995 - 1996	Department of Environment, Ministry of Health, RSS
	Continue monitoring process in this area through at least one station	Ensure adherence to regulations and specifications to be issued for pollution control.	1995	Ministry of Health, Department of Environment, Meteorological Department, RSS
	Establish a network of 5 fixed stations to monitor natural dust accumulation throughout the Kingdom.	Define level of natural dust concentration and study atmospheric impacts in order to contribute to the study of related world climatic changes.	1993	Meteorological Department, Department of Environment

4.2 Recommendations on Legislation and Institutional Improvement

Legislation. It is necessary to issue a comprehensive environmental protection law that includes a special provision for the protection of the atmosphere and air quality. It should also address the authority of official agencies involved in implementing this law, bearing in

mind that current laws, which include legislation concerning the protection of the atmosphere and air quality, do not meet the requirements. These laws are:

- Public Health Law No. 21 of 1971.
- Nuclear Energy and Radiation Prevention Law No. 14 of 1987.
- Ministry of Labour Law No. 20 of 1961.
- Organization Law of Cities, Villages and Buildings, Law No. 79 of 1966.
- Municipalities Law No. 29 of 1955.
- Ministry of Agriculture Law No. 20 of 1973.
- Environment Protection Draft Law.
- Traffic Law No. 14 of 1959.

Independent environmental authority. An independent environmental authority must be created to unify the plans, actions and available capabilities of all concerned agencies.

National Air Quality Centre. Such a centre which would be assigned the following tasks:

- Continuously measuring levels of atmospheric pollutants in Jordan, including radiation and those found in the work environment (noise and odour).
- Establishing an air pollution database.
- Suggesting standard criteria for permissible levels of air pollutants in co-ordination with the concerned agencies.
- Carrying out studies and research necessary to draw up future policies in the field of monitoring and protecting air quality.
- Training technical staff working for the concerned agencies.

Other recommendations. The following actions are recommended:

- a) Encourage the government and the concerned agencies to adopt a comprehensive national information program to spread environmental awareness, and to introduce environmental courses in schools, institutes and universities.
- b) Formulate a comprehensive national plan to prevent causes of air pollution, which all official and non-official agencies must follow.
- c) Approve incentives encouraging the use of clean energy like solar and wind power as alternatives to polluting energy sources.
- d) Adopt a national plan for afforestation, increasing green areas inside cities, and defining land use.
- e) Reduce sulphur and lead content in fuel.
- f) Organize traffic inside cities more efficiently, and encourage the use of public transportation.
- g) Designate certain areas for craft and industrial activities.
- h) Draw up necessary criteria for licensing various industries, encouraging the use of clean technology.
- i) Stress the need to link current and future development projects to environmental impact assessment studies.
- j) Encourage the reuse of domestic and industrial wastes where environmentally and economically feasible.
- k) Formulate emergency responses to pollution incidents, including those related to chemical, biological and nuclear wastes and comprising alarm, detection, purification and preventive measures.
- l) Allocate the necessary funds for research and studies related to problems of a special nature.

5 INFORMATION SOURCES FOR AIR QUALITY

5.1 Noteworthy Research and Technical Documents

- Abanda, Ali and Amin Kara'in. *Climatic Changes*. Meteorological Department.
- Abanda, Ali and Amin Kara'in. *Quantities of Airborne Dust by Khamasini Depressions*. Meteorological Department.

- Abanda, Ali and Amin Kara'in. *Report on the Depletion of the Ozone Layer*. Meteorological Department.
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- Dept. of Environment (1987). *Our Common Future*. International Committee on Environment and Development.
- Faraj, Sa'ed. Study presented by UNEP on Monitoring and Controlling Air Pollution in Jordan, National Research Centre-Egypt.
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- Meteorological Department. (1988). *Jordan Climatological Data Handbook - a Notebook*.
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- Meteorological Department. *Climatic Information on the Turbidity Factor in Jordan*.
- Ministry of Energy. (1987-1990). *Results of Environment Detection and Exposure to Natural Radiation in Jordan*.
- Ministry of Health. (1985). *Air Pollution by Cars in Downtown Amman*.
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- Ministry of Municipal and Rural Affairs and the Environment. (1989). "Air Quality" (Chapter on Air and Noise, pages 49-57) in *State of Environment* (Arabic). Edited by Sufyan Tell and Yaser Sara. Amman, Jordan.
- MMRA&E. (1989). *The Status of the Environment in Jordan*.
- Occupational Health and Safety Institute and Ministry of Health. *A Study on Pollution by Lead in the Batteries Factory-Marka*.
- Occupational Health and Safety Institute. *Effect of Dusts in the Jordanian Wood Co.*
- Occupational Health and Safety Institute. *The Effect of Noise on Workers in the Public Transport Corp.*
- Odat, Ghazi, Hayel Zabin and Ahmad Khatlab. A paper on industrial pollution in Jordan.
- Odat, Ghazi. A paper on pollution from noise and radiation.
- Public Transport Corp. and Greater Amman Municipality. Overall Development Plan of Amman.
- Royal Scientific Society Report on Monitoring Air Pollution in Amman (Final Report, 1990).
- RSS (1990). A study of air pollution by phosphate dust in Aqaba.
- RSS (1990). H₂S Pollution in Hashimiya Township.
- RSS (1990). The First Regional Seminar on Air Pollution.
- RSS (1991). A study on the effect of the dumping site at Russeifa on air pollution.
- Salma, Mustafa M. (1990). *Air Pollution Control Manual*. Jordan Phosphate Mines Co., Ltd.
- Salma, Mustafa M. *Atmospheric Pollution*. Jordan Phosphate Mines Co., Ltd.
- Salma, Mustafa M. *Environmental Aspects - Shadiya Mine Project*. Jordan Phosphate Mines Co., Ltd.
- Salma, Mustafa M. *Environmental Criteria of the Chemical Fertilizer Co. Compound in Aqaba*. Jordan Phosphate Mines Co., Ltd.
- Salma, Mustafa M. *Environmental Standards at the Chemical Fertilizer Co. in Aqaba*. Jordan Phosphate Mines Co., Ltd.
- Swedish Team. Report on Air Pollution in Hashimiya and Aqaba.
- Traffic Department. Statistics on Fuel Consumption in the Kingdom (1983-1987).
- Traffic Department. Statistics on the number of vehicles recorded in the Kingdom (1970-1988).
- Traffic Dept. Statistics on vehicles crossing the borders (1983).
- UNEP. *The Environmental Perspective for the year 2000 and beyond*.

5.2 Noteworthy Maps and Charts

- Greater Amman Municipality. *Population concentration plan of Greater Amman*.
- Greater Amman Municipality. *Traffic densities plan of Greater Amman*.

- Map of waste disposal sites, treatment plants and slaughter houses.
- Meteorological Department. Climatic Atlas of Jordan.
- Meteorological Department. Factory sites in Jordan - map of Jordan.
- Municipality of Greater Amman. Structural plan of Greater Amman till the year 2005.
- National Geographic Centre. Jordan National Atlas - Part one: Climate and Agricultural Meteorology.

5.3 Databases and Specialized Libraries

- Higher Council for Science and Technology, Department of Environment, Royal Scientific Society, Meteorological Department, Nuclear Energy Department, Vocational Health and Safety Institute, Jordanian universities, Abdel Hamid Shoman Library, Environmental Health Activities Centre.

5.4 Recommended Site Visits for a Rapid Appraisal

Several field sites may be visited by investigators wishing to make a rapid appraisal of the environmental conditions discussed in this chapter. Note, however, that these sites have not been selected comprehensively, and other sites may also warrant visitation:

Visits to Pollution Sites

- Downtown Amman.
- Jordan Petroleum Refinery and Hussein Power Plant at Hashimiya.
- Old and new disposal sites at Marka.
- Cement factory at Fuheis.
- Khirbet Samra Treatment Plant at Hashimiya and Sukhna.
- Phosphate Co. and Fertilizers Co. at Aqaba.
- Phosphate Co. at Hasa.
- Quarries and foundries, various locations.
- Toxic and hazardous waste disposal site at Siwaqa.

Other Visits to Key Institutions

- Meteorological Department.
- Royal Scientific Society.
- Ministry of Energy and Mineral Resources.
- Chemical Provision Group of the Armed Forces.
- Civil Defence Department.
- Occupational Health and Safety Institute.

ANNEX 1 - ATMOSPHERE AND AIR POLLUTION TABLES**Table 1 - Examples of Air Criteria and Specifications for Selected Urban Areas**

<i>Pollutants</i>	<i>Canada *</i>	<i>USA</i>	<i>WHO **</i>
SO₂			
Annual	2.3 ppm	0.3 ppm	1.5-2.3 ppm
24 hrs.	11.0 ppm	13.9 ppm	4.7 ppm
1 hr.	34.0 ppm	49.7 ppm	13.4 ppm
98 percentile	-	-	3.8-5.7 ppm
CO			
8 hrs.	13.0 ppm	9.0 ppm	9.0 ppm
1 hr.	31.0 ppm	35.0 ppm	25.0 ppm
NO₂			
Annual	5.3 ppm	5.3 ppm	-
24 hrs.	11.0 ppm	7.9 ppm	-
1 hr.	21.0 ppm	21.0 ppm	-
TSP			
Annual	70.0 ug/m ³	75.0 ug/m ³ ***	60-90 ug/m ³
24 hrs.	120.0 ug/m ³	260.0 ug/m ³	120.0 ug/m ³
98 percentile	-	-	150-230 ug/m ³

* Maximum acceptable level. ** Proposed guidelines. *** Annual geometric average.

Table 2 - Maximum Acceptable Occupational Limits (ppm)

<i>Pollutant</i>	<i>Britain</i>	<i>UN</i>	<i>USA</i>	<i>Canada</i>
SO ₂	2.0	5.0	5.0	5.0
CO ₂	5,000.0	5,000.0	5,000.0	5,000.0
CO	50.0	50.0	50.0	50.0
NO _x	3.0	5.0	5.0	5.0
O ₃	0.1	0.1	0.1	0.1
H ₂ S	10.0	10.0	10.0	10.0
NH ₃	25.0	25.0	50.0	25.0
F ₂	-	1.0	1.0	1.0
Cl ₂	1.0	1.0	1.0	1.0
TSP				60-90 ug/m ³ 0

Maximum Acceptable Radiation Doses in Jordan: (i) For workers subject to radioactive hazards: 50mSv/yr. (ii) For the general public: 5mSv/yr.

Table 3 – Principal Stationary Sources of Air Pollution & Contaminants

<i>Type of Source</i>	<i>Types of Air Contaminants</i>
Petroleum Refinery (Zarqa)	CO, CO ₂ , H ₂ S, SO ₂ and Hydrocarbons
Hussein Thermal Power Plant (Zarqa)	CO, CO ₂ , SO ₂ , NO _x
Cement factories (Fuheis, Qadisiya, Dhuleil)	Dust
Phosphate mines (Russeifa, Hasa, Shadiya, Abyad)	Dust
Industrial estates in E. Amman, Russeifa, Awajan, Zarqa, Sahab; and plants for iron and steel, tanning leather, chemical detergents, and batteries.	Cl ₂ , F ₂ , Pb, SO ₂ , CO
Quarries and asphalt mixing	Dust, CO, CO ₂ , SiO ₂
Fires, waste burning, grass burning, tyre burning	CO ₂ , CO
Phosphate and potash loading (Aqaba)	Dust
Fertilizer Plant (Aqaba)	F ₂ , NH ₃ , SO ₂
Glass factory (Ma'an)	SO ₂ , CO, CO ₂
Loading and discharging at crop silos in Aqaba	Dust
Treatment plants (most important one at Khirbet Samra)	Odour, H ₂ S, NH ₃ , CH ₄
Potash Plant (Ghor Safi)	Dust, SO ₂ , CO ₂
Crude oil loading (Aqaba)	Hydrocarbons
Gas stations	Hydrocarbons
Bakeries in all areas	CO, CO ₂ , SO ₂
Power plants (Marka)	CO, CO ₂ , SO ₂
Domestic activities: cooking, heating, cleaning, using insecticides	Propane, SO ₂ , components of insecticides particles

ANNEX 2- INFORMATION ON AIR QUALITY WORKING GROUP

A-2.1 Current Membership of the Committee with Affiliations

Dr. Abdullah Toukan	Committee Chairman, HCST
Eng. Ishaq El-Majali	Jordan Armed Forces
Mr. Deeb El Mi'ani	Civil Defence, Ministry of Interior
Mr. Hussein Khandaq	Ministry of Health and Social Development
Eng. Hayel Zabin	Department of Environment, MMRA&E
Eng. Hussein Shahin	Department of Environment, MMRA&E
Eng. Ayman El Hasan	Royal Scientific Society
Eng. Ra'fat El-Asi	Jordan Soc. for the Control of Environmental Pollution
Dr. Ali Abandah	Meteorological Department (Rapporteur)
Dr. Amin Kara'in	Meteorological Department
Eng. Abdel Rahim Abdel Jaber	Vocational Training Corporation, Occupational Health and Safety Institute
Mr. Ahmad Muhammad Mansi	Ministry of Energy and Mineral Resources

A-2.2 Current List of On-Call Members

Eng. Suhair Amawi	Ministry of Industry and Trade
Eng. Anas Qattan	Greater Amman Municipality
Mr. Mustafa Salma	Jordan Phosphate Mines Co.
Eng. Jamal Odat	Public Transport Corp.
Eng. Hani Khammash	Jordan Cement Factories Co.
Eng. Baha Ed-Din Faidi	Jordan Petroleum Refinery Co.

A-2.3 The Following Persons also Attended Committee Meetings

Eng. Jamal Jallouqa	Greater Amman Municipality
Eng. Tawfiq Abu Hamad	Occupational Health and Safety Institute
Eng. Zuhair Abdel Karim	Civil Defence
Eng. Amin El Hroub	Traffic Dept., Ministry of Interior
Mr. Mazen Khalil	Ministry of Health and Social Development
Eng. Muhammad Nayroukh	Ministry of Energy and Mineral Resources
Dr. Arafat Tamimi	Higher Council for Science and Technology
Dr. Dia' Ed-Din Arafa	University of Jordan

ANNEX 3 - INFORMATION ON KEY SOURCES OF ATMOSPHERE AND AIR QUALITY INFORMATION

A-3.1 Names and Affiliations of Specialists (includes Working Committee)

Dr. Ibrahim Badran	Ministry of Industry and Trade
Eng. Rashad Abu Ras	Electricity Authority
Eng. Ali El-Mur	Ministry of Energy and Mineral Resources
Eng. Ali El Ajluni	Royal Scientific Society
Dr. Najeh Aqil	Royal Scientific Society
Mr. Majdi Taim	Royal Scientific Society
Mr. Isa Hussein	Meteorological Department
Mr. In'am Tahboub	Meteorological Department
Eng. Ibrahim El- Atawi	Meteorological Department
Eng. Kamal Jallouqa	Greater Amman Municipality
Dr. Said Najjar	Greater Amman Municipality
Eng. Mohammad Bani Hani	Greater Amman Municipality
Eng. Tawfiq Abu Hamad	Occupational Health and Safety Institute
Mr. Khalil Dodin	Occupational Health and Safety Institute
Mr. Jamal El Jundi	Occupational Health and Safety Institute
Eng. Amal Hijazi	Occupational Health and Safety Institute
Mr. Abdel Karim Rushrash	Civil Defence
Dr. Moh'd Said Subbarini	Yarmouk University
Dr. Sameh Gharaibeh	Yarmouk University
Dr. Ihsan Shokaji	University of Jordan
Eng. Ghazi Odat	Department of Environment
Eng. Izzat Abu Hamra	Department of Environment
Eng. Abdel Karim Zyudi	Department of Environment

A-3.2 Names and Addresses of Useful International Agencies

Arab Institute for Occupational Health and Safety Occupational Housing Complex, P.O. Box 577 Damascus - Dummar Syria	OSHA - U.S. Department of Labor Occupational Safety and Health Administration Washington, D.C. 20210 USA
Environment Canada Ottawa, Ontario Canada K1A 0E7	UNEP and INFOTERRA P.O. Box 30552, Nairobi Kenya
International Atomic Energy Agency Wagramerstrasse 5 P.O. Box 100 A-1400 Vienna Austria	United States Environmental Protection Agency (USEPA) 401 M St., SW Washington, D.C. 20460 USA
National Centre for Occupational Health and Safety Al Mujama' Al Omalieyeh Baghdad, Al Wazirieyeh Iraq	World Meteorological Organization (WMO) 41, Avenue Giuseppe Motta Case Postale 2300 1211 Geneva 2 Switzerland

Oil Research Institute
Baghdad, Al Jadilieyh
Iraq

ANNEX 4 - SOURCES OF AIR CONTAMINANTS

Air is considered an important resource that has no geographic boundaries; therefore, conservation of this resource is both a national and an international responsibility. The air pollution affecting western Iran and northeastern Saudi Arabia, which emanates from the Kuwaiti oil well fires of 1991, is a dramatic case in point.

A-4.1 Total Suspended Particulates (TSP)

These are the solid and liquid suspended particulates in the air with a diameter of less than 100 microns. In addition to naturally occurring desert dust, sources of this pollutant include transportation, fuel combustion from stationary sources, industries, brush and grass fires, and dust from unpaved roads.

Prevention and control of dust pollution is achieved by separating and collecting dust at its source, using methods such as settling chambers, cyclones, wet scrubbers, electrostatic precipitators and bag filters.

A-4.2 Industrial Pollutants

SO₂. This pollutant results from the combustion of fuel containing sulphur. The major sources of this gaseous pollutant are power plants, vehicles and melting ovens. Emissions of this gas are controlled by absorption, adsorption and catalytic conversion.

CO. This pollutant arises through incomplete combustion in vehicle engines, especially gasoline engines.

NO_x. The gases referred to here are NO and NO₂. The major sources are fuel combustion from stationary plants and exhaust from vehicles.

Hydrocarbons. Sources of these materials are petroleum refineries, vehicles, paint industries and tanneries.

Oxidizers arising from solar radiation: these oxidizers result from a series of reactions of hydrocarbonic materials with nitrogen oxides in the presence of sunlight. They are more capable of oxidation than oxygen is. The most important of these are ozone and peroxyacetylnitrate compound (PAN).

CO₂. Results from all combustion processes and some other chemical reactions.

H₂S. Results from refining of hydrocarbons containing sulphur, and during anaerobic decay of organic matter in treatment plants and sewerage systems. This pollutant can be controlled during refining with special equipment.

NH₃. By-product of fertilizers, refrigeration industries and oil refining. It is an irritating and noxious inorganic gas.

F₂. Not a pollutant on its own, but when it reacts with water certain pollutants materialize such as O₃ and hydrogen fluoride. F₂ is used in chemical and petrochemical industries.

CFCs and Halons. Used in refrigeration processes, sponge industries, aerosol containers and fire extinguishers.

Insecticides. Produce various harmful organic and chemical materials if released into the atmosphere.

NO₃, SO₄. Composed through the oxidation of nitrogen oxides and SO₂ in the clouds. They react slowly and cause acid rain. SO₄ sedimentation is a by-product of fixed sources of pollution such as power plants and fuel uses. The level of NO₃ sedimentation can indicate mobile sources (vehicles).

Pb. Lead is a heavy toxic metal used in many industries such as those producing batteries and base paints, and in the upgrading of petrol octane. The main source of lead emissions is vehicle exhaust, in countries using leaded gasoline.

Cl₂. Used in chemical industries such as detergents and in water chlorination.

Hg. A heavy toxic metal, used in chlorine and insecticide production, and in other industries.

Other. All vapours and harmful gases which occur within the work environment.

A-4.3 Greenhouse Gases

CO₂. The concentration of CO₂ in the atmosphere in 1990 was 353 ppm, estimated to be 25% higher than it was before the industrial revolution (1750-1800), when it was 280 ppm. The concentration of CO₂ is increasing at the rate of 1.8 ppm annually and is expected to reach 415-480 ppm by the year 2050, and 460-560 ppm by 2100. If present concentrations in the atmosphere are to be controlled, global CO₂ production should be decreased by 60-80%.

CH₄. Its concentration in the atmosphere at present is 1.72 ppm, which is double the concentration prevailing before the industrial revolution. It increases by 0.015 ppm annually, and if its present concentration is to be maintained its production must be reduced by 15-20% worldwide.

CFCs. The concentrations of CFCs are as follows:

CFC-11: 280 ppt; CFC-12: 484 ppt; CFC-13: 60 ppt; CFC-14: 146 ppt. They all increase by 4% annually. The rate of increase of these pollutants is expected to decline after the year 2010 as a result of international negotiations to strengthen control systems over the production of CFCs (see Montreal Protocol). However, concentration values of CFC-11, 12 and 13 will continue to be 30-40% of the present rate during the next century because of their long persistence in the atmosphere. Jordan imports around 300 tons of CFCs annually, which comprise 0.0003% of world production of these materials (world production in 1984 reached 1.2 million tons).

CFCs raise the earth's temperatures and deplete the ozone layer in the atmosphere, especially in the stratosphere layer (10-50 km from the Earth's surface) which protects the Earth's surface from ultraviolet rays. Scientists agree that a decrease in the ozone column has occurred over the last 20 years by almost 3% in the northern hemisphere, and in the area of latitudes 30°-64° north (4% in summer and 1% in winter). In Antarctica, total ozone loss averages 50% or more.

Nitrous Oxide (N₂O). The rate of concentration of N₂O in the atmosphere is 310 ppb, which is 8% higher than that prevailing before the industrial revolution. It increases in the atmosphere by 0.8 ppb annually. To control pollution by N₂O, its release into the atmosphere must be reduced by 70-80%.

Ozone (O₃). Ozone is one of the greenhouse gases, especially prevalent in the troposphere (earth surface to 10 km) and the lower stratosphere. Its concentration in the troposphere is variable because of its short life. It is produced naturally in this layer as a result of photo-chemical operations and complex reactions of CO, nitrogen oxides, hydrocarbons and methane. In addition, it is transferred from the stratosphere through depressions, air fronts and general wind circulation.

In Jordan, O₃ concentration is increasing near the earth's surface—especially in Amman—due to pollutants such as hydrocarbonic materials and NO_x from vehicle exhaust. One hundred and fifty thousand vehicles were registered in Amman in 1982, and it has been estimated that they annually produce almost 55,000 tons of air pollutants, such as CO and nitrogen oxides. The increase of greenhouse pollutant gases mentioned above has been accompanied by an increase of 0-4°C in the earth's temperature. The CO₂ increase caused 85% of the temperature increase and the other greenhouse gases caused the remaining 15%.

Studies of climatic changes indicate that by the year 2050, with the increase of those pollutants, temperatures on earth will increase by 4-5°C. The increase may reach 10°C in the polar region and 3°C in the equatorial region. This will contribute to a sealevel rise of 1.5 m, which is sufficient to drown thousands of coastal settlements. Furthermore, saline water would reach groundwater sources and pollute them. Such a rise in sea-level would not be catastrophic to the Jordanian coast at Aqaba, but reduced precipitation could be disastrous. Climatologists expect that precipitation would increase in the polar regions. Evaporation would increase and precipitation decrease around latitudes 25° north and 35° south, where Jordan and most other Arab countries are located.

A-4.4 Aerosol and Radioactive Particles

The aerosol particles' life persistence rate in the troposphere layer is several weeks. They are found in variable quantities, and are produced by fuel combustion and industrial uses (such as sulphur). These particles cause acid rain and affect the formation of clouds and the thermal balance. Their concentration in the atmosphere has doubled globally. On the other hand, the particles, which are emitted into the atmosphere through natural phenomena causes such as sandstorms and volcanoes, have the effect of decreasing temperatures on earth, contrary to the effect of greenhouse gases.

Radioactive materials. These appear in the form of radioactive isotopes and heavy ions suspended in the air, and are carried by particles of dust.

11 • Antiquities & Cultural Resources³⁴

Archaeological remains pertains to both sites and buildings of archaeological significance. Jordan contains a wealth of archaeological remains, some of which are of world renown and many others of intense research interest to scholars.

1 BASIC DEFINITIONS AND PRINCIPAL ISSUES

1.1 Antiquity Defined

The Antiquities Law defines the term antiquity to be:

a) *Any object, whether movable or immovable, which has been constructed, shaped, inscribed, erected, excavated, or otherwise produced or modified by humankind earlier than the year A.D. 1700 including caves, sculpture, coins, pottery, manuscripts and all sorts of artifacts that indicate the rise and development of sciences, arts, manufacturing, religions and traditions relating to previous cultures, or any part added thereto, reconstructed or restored at a later date.*

b) *Any object, movable or immovable, as defined in the previous sub-section referring to a date subsequent to the year A.D. 1700, which the minister may declare to be antique by order of the Official Gazette.*

c) *Human, plant and animal remains going back to a date earlier than A.D. 600.*

1.2 List of Archaeological Sites

A list of archaeological sites in Jordan may be obtained from the following references:

- a) The archives of the Department of Antiquities Registration and Research Centre. (P.O. Box 88. Amman-Jordan. Tel: 644336 - 641275)
- b) The Annual of the Department of Antiquities of Jordan. (ADAJ). V1-V34. 1951-1990, Amman-Jordan.
- c) The volumes of the Conferences on the History and Archaeology of Jordan:
 - Vol. 1: *General Studies in the History and Archaeology of Jordan*. Edited by Adnan Hadidi. 1982. Amman.
 - Vol. 2: *Jordanian Environment: Geographical and Historical*. Edited by Adnan Hadidi. 1985. Amman.
 - Vol. 3: *Trade, Communications and International Relations to the End of the Ottoman Period*. Edited by Adnan Hadidi. 1987. Amman.
 - Vol. 4: *Settlement Patterns in Jordan*. (In preparation).
- d) The 1973 Antiquities Inventory available at the Department of Antiquities. (P.O. Box 88. Amman-Jordan. Tel: 644336 - 641275)
- e) *Akkadika Periodical*. Prof. Dr. Denyse Homes-Fredericq and Prof. Basil Hennessy, Musée Royaux d'Art et d'Histoire, Parc de Cinquantenaire, 10, 1040 Bruxelles, Belgium. 1977-1990.

1.3 Traditional Buildings

Definition. Architectural units, building complexes and urban forms like streets, alleys and plazas that are not included in the Antiquities Law and that have religious, architectural or social significance and that altogether form the architectural heritage of Jordan (A.D. 1700-1950).

Significant buildings. Buildings considered part of Jordan's national heritage may be obtained from the following references:

³⁴Information in this chapter was prepared by the Antiquities Committee, under the chairmanship of Mr. Nasri Atalla, Secretary General, Ministry of Tourism

- The departments of architecture at the various Jordanian universities. (University of Jordan, Amman-Jordan. Tel: 843555) (Yarmouk University, P.O. Box 566. Irbid-Jordan. Tel: 02-271100)
- The Institute of Archaeology and Anthropology and the Centre for Jordanian Studies at Yarmouk University. (P.O. Box 566. Irbid-Jordan. Tel: 02-271100)
- The international institutes for history and archaeology in Jordan.
- Reports and books on the subject, like: *Traditional Architecture in Jordan*, Vol. 1, *Salt*. Royal Scientific Society. 1990. Amman. Another example is Talib Rafa'i and Ruba Kana'an. *Buyut Amman el-Ula*. 1982. Amman.
- Royal Scientific Society (P.O. Box 925819. Amman-Jordan. Tel: 844701)
- Royal Society for the Conservation of Nature. (P.O. Box 6354. Amman, Jordan. Tel: 811689)

1.4 Choosing Priorities

The determination of which sites need technical and comprehensive evaluation, to set priorities for expropriation and preservation that must follow a computerized database for the sites, could be aided by the following considerations:

The chronological and historical importance of archaeological sites like Basta in southern Jordan and Ain Ghazal in Amman from the Neolithic period, Tell Abu Hamid and Teleilat Ghasul from the Chalcolithic period, Khirbet Zeiraqun and Bab Dhra from the Bronze Age and Um Rasas from the Byzantine period.

Less significant sites in planned areas that could be recorded and then relegated for development, and partially-demolished sites in agricultural areas.

1.5 Range of Issues

- Development of site inventory for antiquities and for traditional buildings.
- Legislation concerning the expropriation law; planning and zoning, and environmental impact assessment.
- Institutional changes.
- Zoning and planning for reserves and heritage management.
- Touristic and recreational development of private sector projects and public parks.
- Preservation and conservation of buildings and archaeological finds and artifacts.
- Archaeological excavation, support for technical laboratories and training.
- Salvage and rescue with respect to excavation and preservation.
- The Antiquities Law.
- Public education and awareness.
- The educational role of museums.

1.6 Summary of Recommendations

- Official inventories of antiquities and traditional buildings based on a computerized database.
- Institutional co-ordination.
- Training and technical assessment and the creation of national technical laboratories.
- Museums, exhibitions and education.

2 OVERVIEW OF ARCHAEOLOGICAL AND TRADITIONAL RESOURCES

2.1 Identification of Archaeological and Traditional Remains

Archaeological remains. Archaeological remains include sites and buildings of archaeological significance. Jordan contains a wealth of archaeological remains. Some of these, like Jerash, Petra and Madaba-Mount Nebo are world famous and attract many tourists. Others, like the Amman Citadel, the Umayyad, Crusader and Mamluke castles, Pella, Um Qeis, Um Jimal and Um Rasas, are of outstanding national significance and of international repute among veteran tourists and scholars.

Still others, like Ain Ghazal, Basta, Bab Dhra, Khirbet Zeiraqun, Tell Hesban, Tell Deir Alla and Ayla, which have been the focus of intense excavation and publication, are world-famous among scholars, and are to be counted among the world's precious cultural monuments. Sites like Tell Husn and Um Qutein are also well-known but have not yet received scholarly attention. Finally, there are hundreds of sites known from surveys and accidental discoveries, and numerous as yet undiscovered sites whose significance cannot be assessed until they are studied.

Traditional buildings and sites. Although formal Ottoman-era building activities in Jordan did not stop (e.g., the Hajj forts) in the two centuries before 1850, there was a gap in civilian urban and rural construction, with site occupation limited to tents and caves. However, in the second half of the nineteenth century active private development resumed, so that by the beginning of this century there were numerous towns, like Salt, and villages, like Um Qeis, and fortified farmsteads, like Yaduda, built in a localized Late Ottoman Mediterranean style. As the population grew in the Mandate period, this style evolved into the more elaborate limestone architecture of downtown Amman, on the one hand, and the simpler mudbrick and reused limestone villages of the rural areas, on the other. This second phase lasted from the twenties till after World War II.

The third phase, the international style, lasted from the late fifties to 1967. Buildings designed by engineers and architects who studied abroad after the war featured more elaborate plans and concrete walls faced with stone veneer, visible in the houses of Jabal Amman's Third Circle area. What distinguishes these traditional buildings from archaeological remains is that they are still standing and often still have a practical function. They also fit directly into the development of modern Jordanian culture, so that they enjoy a much greater heritage awareness among the Jordanian public.

What distinguishes them from the modern buildings of Jordan is that they are rapidly losing their original function. In the first two phases this means abandonment in many cases, so that many are rapidly turning into ruins threatened by the bulldozer for redevelopment of the land they occupy. For some buildings of the second phase and many of the third phase this means a reassignment of use, sometimes as slum dwellings, sometimes as government or business offices. In the latter case the treatment varies from ruinous neglect to radical remodeling (without attention to the original design) to thoughtful restoration.

Current status. While a few archaeological sites (Jerash, Petra) have received some attention, the vast majority of archaeological and traditional remains suffer from neglect, decay and destruction. The reasons for this are economic (there is no money for conservation) and cultural (there is low but growing awareness of the importance of cultural heritage). Exposed archaeological remains and standing traditional buildings are in a process of decay that far outstrips current means and efforts of conservation.

3 CURRENT AND FUTURE TRENDS

Public awareness of the importance of cultural remains is increasing, but slowly. Some private groups (the Friends of Archaeology, the Petra National Trust, the RSCN, foreign archaeological institutes) are increasingly assisting public agencies. University programmes are having an impact on a growing number of young graduates. Nevertheless, the process of decay promises to continue unless this popular sentiment develops rapidly into authoritative regulations, and unless financial priorities are given to heritage protection in the national budget.

The current growth of tourism is an opportunity to devote new income to the conservation of heritage sites. There is already some evidence that this can happen in the private sector (the reconstruction of Yaduda for Kan Zaman). However, with present financial procedures, there is little chance that income from tourism can flow into the conservation budgets of public agencies like the Department of Antiquities. The increase in tourism is also an opportunity to broaden the focus from the two main traditionally visited sites to the

large number of other interesting and important sites which could lead to greater conservation efforts at those sites.

3.1 Implications for Jordan's Development Prospects

Conservation of archaeological and traditional remains has two important influences on development, one cultural, the other economic. First, Jordan is a young country that would benefit from the conservation of its antiquities for the creation of a national sense of heritage and identity. Second, conserved antiquities are the backbone of Jordan's tourism industry. The building of hotels without the conservation of historical sites would be the building of hollow shells. Neglected antiquities will mean empty hotels in the long run. From a development point of view, the preservation of antiquities is an essential investment for the future economic and cultural well-being of the nation.

4 REASONS FOR DEGRADATION

4.1 Destructive Practices and Pressures

Archaeological remains. The main problems relating to the preservation and enhancement of archaeological remains are:

- a) There is no comprehensive land-use law.
- b) There is no comprehensive inventory of sites available to planning and development agencies.
- c) Most sites are privately owned; owners have no clear understanding of their responsibilities for the antiquities on their properties.
- d) Owners often see antiquities on their land as a hindrance to development rather than as a precious possession, which results in destruction, not preservation, of privately owned antiquities.
- e) The existing antiquities law, though strong and sufficient for protecting archaeological remains, is unevenly and inadequately enforced or implemented. The blatant neglect of the existing law causes much destruction.
- f) The value and attractiveness of archaeological sites are often reduced by unsympathetic developments, both in and near them. The effective preservation of a site is often hampered by what is done next to it, as much as by what is done on it.
- g) Exposed archaeological remains are subject to severe erosion through natural processes.

Traditional buildings and sites. While much destruction of traditional buildings has been taking place, there have also been some imaginative examples of restoration and reuse. Some of these are: the remodeling at Um Qeis of Beit Malkawi as an excavation headquarters and of Beit Rusan as a museum visitors' centre; the RSCN's efforts in Salt; University of Jordan, Department of Architecture studies of urban dwellings and village plans like Rmeimin; the restoration of one part of Yaduda for private use and another part for commercial purposes (Kan Zaman); and the remodeling of the Sherif Hussein House as the Aqaba Visitors' Centre.

Nevertheless, the main problems related to the establishment of successful preservation policies are:

- a) The lack of legislation for the preservation of traditional buildings.
- b) The absence of an official inventory of traditional architecture.
- c) The lack of public awareness and support for preservation. There is, however, increasing effort (due to the leadership of professors at Yarmouk and Jordan Universities), enthusiasm in the artistic and architectural community, and the inclusion of traditional buildings in the conservation efforts of the Royal Society for the Conservation of Nature.
- d) The location of traditional buildings within central city and district centre locations, where pressures for development are greatest and property values tend to be high.
- e) Private ownership and the rapid rate of demolition and alteration of the few remaining buildings. The presumed lack of worth of dilapidated traditional village houses, especially in rural areas, makes their destruction casual and common.

4.2 Bio-Physical and Socio-Economic Influences

Bio-physical. Both archaeological and traditional remains are extremely vulnerable to natural and human erosive forces, due to the tendency to ignore preventive maintenance. Excavation of an archaeological remain brings with it the immediate responsibility of preservation and ongoing maintenance. Most often, provisions for these are not made.

Socio-economic influences include the following:

- a) Jordanian culture shares the nearly universal modern myth that progress means modernity, and that old things are a hindrance to social status and economic progress.
- b) An exception to this is the myth that some old things are treasure. An immeasurable cause of the destruction of archaeological remains is the search for treasure (Turkish gold).
- c) Lack of inter-agency coordination in planning and implementation of public works.
- d) The growing fashion of displaying archaeological objects in living rooms.
- e) The lack of financial resources for site maintenance.
- f) The high financial cost of conservation, preservation and reconstruction.

5 PRESERVING HERITAGE RESOURCES

5.1 Archaeological remains

General. The following recommendations aim at promoting the preservation and enhancement of the most significant archaeological remains in the country, to serve the following purposes:

- to maximize their potential as important visual elements in Jordan's urban and rural landscapes.
- to make them an effective educational and recreational resource.
- to make them effective attractions for domestic and international tourism.

Inventory of archaeological remains. The Antiquities and Cultural Resources Committee recommends the production of a comprehensive inventory of archaeological remains from the resources listed in Section 2. This list should be officially adopted by the government, updated regularly, and circulated widely among ministries and implementation agencies in order to prevent further destruction of archaeological remains. Private and public owners should be informed of the archaeological remains on their properties.

If possible, this inventory should receive statutory recognition, and archaeological sites and structures should be included on the property titles registered at the Department of Lands and Survey. The major resources for compiling such a list of sites are detailed in section 1.2 *List of Archaeological Sites*.

Acquisition. Many important archaeological sites are already owned by the Department of Antiquities, but others, like Ain Ghazal, Basta and Ayla, remain in private hands. A list of sites designated for purchase by, or on behalf of, the Department of Antiquities should be compiled.

It is also important for the authorities to acquire, or to impose, zoning restrictions on land adjacent to important heritage sites to prevent the creation of unattractive settings for these sites. Obvious examples are the slopes of the Amman Citadel (where the municipality plan has made such provisions), and the land in the wadi between the Petra Rest House and the Siq entrance. Land may also need to be acquired, or rules of ingress and egress applied, in order to provide public access, an adequate visual setting, and visitor facilities.

Sites for touristic and recreational purposes. From among those sites listed as "of outstanding national importance," a list of sites should be drawn up to be designated for development. The following general guidelines should be applied to such site development:

- a) The Departments of Tourism and Antiquities, in co-operation with the proper government ministry, should work to develop these sites as local, district or national parks. The antiquities should be restored to a high standard and adequate excavation carried out.

- b) Sites should have durable signs with appropriate information, be well lighted for night use where feasible, and be adequately but attractively secured.
- c) Sufficient land should be acquired to provide an adequate visual setting, allow appropriate landscaping and visitor facilities, provide public access, and permit additional excavation.
- d) The antiquities and surrounding areas should be well-maintained and supervised to prevent vandalism, garbage accumulation and further decay of the antiquities.

Training and Personnel Development. The staff of the Department of Antiquities and of other concerned institutes should be professionally trained in:

- a) Preservation and conservation techniques for building remains and archaeological finds and artifacts.
- b) Archaeological excavation and interpretation by use of modern technical methods.
- c) Salvage and rescue techniques in excavation and preservation.

National technical laboratory. A national or regional technical laboratory for preservation and conservation of buildings and artifacts should be established in one of the universities to provide direct access to highly specialized services and adequate personnel.

5.2 Traditional buildings and sites

Aims of recommendations.

- a) To stop further destruction of important traditional buildings and sites.
- b) To propose positive ways of preserving important buildings and townscapes.
- c) To encourage imaginative remodeling and modernization to improve comforts for the occupants.

Official inventory of traditional buildings and sites. All traditional buildings and sites should be listed in a catalogue based on the research done to date by the departments and institutes of archaeology and anthropology and the departments of architecture at the University of Jordan and the Jordan University of Science and Technology. This list is to be completed and updated with ongoing fieldwork in the cities, towns and villages of Jordan. Such a list ideally should be an information catalogue including graphic, photographic and verbal descriptions of the buildings and sites included. Criteria for inclusion in the list are:

- a) Age: all buildings constructed before 1914, e.g., the core houses of Wadi Sir.
- b) Architectural character and quality: this should include both architectural excellence and representation of a particular period's and locality's style, e.g., the Bisharat House in Jabal Joufeh, Amman.
- c) Historical associations with a well-known person or event, e.g., Fath Mosque, King Abdallah's place of prayer.
- d) Association with an archaeological site "of outstanding national importance", e.g., the recently demolished Bilbeisi House and the two rural-type stone houses behind the Roman theatre in Amman.
- e) Examples of social and economic development, e.g., the 1910 flour mills in the Wadi Lejjun, or the Turkish bath on Hammam Street in Amman.
- f) Urban patterns and fabrics. Groups of important buildings and their interrelationships, e.g., the circular street, *ahwash* pattern of Rmeimin.
- g) Technical innovations of historic importance; new building methods and designs, e.g., the railway bridges throughout the country, or vault-suspended stairways.

The process of identifying traditional sites is itself in the beginning stages. Sources of information are:

- The departments of architecture at the various Jordanian universities. (University of Jordan. Amman-Jordan. Tel: 843555)
- The Institute of Archaeology and Anthropology and the Centre for Jordanian Studies at Yarmouk University. (P.O. Box 566. Irbid-Jordan. Tel: 02-271100)
- The international institutes for history and archaeology in Jordan.

- Reports and books on the subject like: *Traditional Architecture in Jordan, Vol. 1*. Salt: Royal Scientific Society. 1990. Amman. Another example is Talib Rafa'i and Ruba Kana'an, *Buyut Amman Ula*. 1982. Amman.
- Royal Scientific Society (P.O. Box 925819. Amman, Jordan. Tel: 844701)
- Royal Society for the Conservation of Nature (P.O. Box 6354. Amman, Jordan. Tel: 811689)

The department or agency to oversee traditional buildings and sites should be given the responsibility of drawing up the inventory and acquisition list.

Acquisition. From the inventory of traditional buildings and sites a smaller list should be drawn up of those buildings and structures that should and can only be saved by acquisition.

Conservation. Because there is no agency for the preservation and ownership of traditional buildings and structures, conservation programmes have to be promoted among the present private and public owners. Some precedents have been set. Many traditional buildings have been adapted for public use, and some private individuals and societies have been actively engaged in saving and preserving traditional buildings.

Architectural salvage. A useful initiative would be the establishment of a storage bank of traditional stone fragments from buildings that have been or must be destroyed, as a resource for the rehabilitation of traditional buildings.

6 RECOMMENDATIONS ON POLICY AND MANAGEMENT

6.1 Environmental Policy Changes

Environmental Impact Assessment: the current "Environmental Impact Review System" adopted by the Ministry of Planning (the official body responsible for channeling international funding) is not enforced on the international development funding agencies but is self-imposed by some of these agencies (USAID, World Bank) on all their sponsored projects.

A description of the existing system presents opportunities to increase effective recording and preservation of a proposed site.

- 1) The ministry does not have written guidelines to direct the carrying out of feasibility studies. As a result, the scope of any feasibility study for a major development project will not necessarily include the study of potential cultural impacts.
- 2) Cultural property rescue is not integrated into project design in a systematic, routine manner.
- 3) Adequate reconnaissance surveys of cultural property are not conducted routinely or early enough.

Planning and zoning control: the areas around sites "of outstanding national importance" should be subject to special planning and zoning controls, to ensure that new developments do not detract from the visual amenity of these monuments (e.g., this could have prevented the placement of massive electricity transformers in the visual field of Qasr Kharana).

Such controls would both protect important views and regulate activities and structures that may damage or be incompatible with the archaeological remains, (e.g., the construction of a high-rise hotel to overshadow the Temple of Artemis at Jerash; the construction of a cement factory anywhere upwind of Qasr Amra).

6.2 Institutional Changes

Until now, no government agency is designated to carry out policies and procedures for traditional buildings and sites. These should be assigned to the appropriate government agency such as the Department of Antiquities or the Ministry of Culture, which would be assigned to carry out the following:

- a) Draw up the inventory of traditional buildings and structures. This should include photogrammetric and graphic recording processes. The architectural services of the universities' departments of architecture and the photogrammetric services of the Royal Geographic Centre could be used for this purpose.
- b) Promote passing and enforcing new laws governing traditional buildings and structures.
- c) Promote the value of conserving traditional architecture and town patterns among the general public, among government agencies responsible for building permits, zoning and planning, and among private and public owners of properties listed in the inventories.
- d) Find ways of funding preservation and compensating owners.
- e) Work out the means of public ownership of traditional buildings on the acquisition list, or the means of responsible private ownership of buildings on the inventory or acquisition list threatened by destruction.
- f) Build up the necessary professional and technical expertise for the conservation and rehabilitation of old buildings.

6.3 Legislative Initiatives

Jordan has an all-encompassing law which sets and regulates policies and imposes penalties for dealing with archaeological sites and artifacts (the Antiquities Law of the Hashemite Kingdom of Jordan). However, specific provisions are needed to enforce the intent of the law and the application of its penalties. Other essential enforcement provisions are:

- a) That official permission must be obtained from the Department of Antiquities for any works that may affect archaeological remains, including works by government departments and public utilities.
- b) That official development organizations in Jordan make provisions for additional sums for archaeological work to be included in development project contracts.
- c) That entrance fees collected by the Jordanian Finance Ministry through the Department of Antiquities be re-channelled to restoration and preservation of archaeological sites.

Traditional buildings and sites: unlike archaeological remains, no legislation covers traditional sites; this calls for the immediate passage of legislation to cover the catalogue of traditional sites. Such legislation should include at least:

- The requirement of official permission to alter or demolish any building or structure in the catalogue of traditional sites.
- The enactment of specific remodeling restrictions on buildings and neighbourhoods defined by law as heritage areas (a selection of the significant items from the catalogue).
- Measures to allow government agencies to create financial incentives to make repairs and pay compensation for loss of income if demolition and remodeling works are refused.
- The imposition of substantial penalties and fines for breaking these laws.

6.4 Public Awareness, Consultation and Participation

Education: the key to preservation of the archaeological heritage is popular interest and support. To achieve this it is necessary to begin teaching the significance and meaning of archaeological remains at an early age.

Units on the archaeology of Jordan should be made a regular part of the required curriculum in the public and private schools of Jordan, and teachers should be fully prepared to present these units to their pupils. In order to make teachers familiar enough with Jordan's archaeological heritage to be able to prepare and teach units on it, archaeology should be taught in the teacher training programmes of the universities and community colleges. Familiarity with major archaeological sites and museums would allow teachers to function as informed guides during class visits to major archaeological sites and museums.

Parallel to the teaching of archaeology, the teaching of traditional heritage should be included in teacher training colleges and public and private schools. Teaching children about traditional town and village architecture, and especially introducing city children to the

village landscape, would do much toward building a sense of the uniqueness and value of Jordan's heritage. Such education would provide a concrete background to the meaning of being Jordanian, and would associate a love for the traditional with self-worth.

Also useful would be the promotion of non-governmental societies that enhance public awareness about the role of individuals in cultural preservation, as well as including a student chapter in these societies, which include:

- Royal Society for the Conservation of Nature. (P.O. Box 6354. Amman-Jordan. Tel: 811689)
- Friends of Archaeology Society. (P.O. Box 2440. Amman, Jordan. Tel: 659987)
- Friends of the Museum, Yarmouk University, Irbid. (P.O. Box 566. Irbid, Jordan. Tel: 02-271100)
- Petra National Trust. (Telex 21323. Tel: 659978)

Cultural Resource Management: the Cultural Resource Management Project of the Department of Antiquities is directed to address the problem of extensive and needless destruction of archaeological and traditional sites as a result of rapid and unrestricted economic development. The roles performed by the project include:

- Preventive planning and provisions for salvage and rescue operations.
- Planning co-ordination for the Department of Antiquities.
- Public awareness and cultural education.

The Cultural Resource Management Programme should be used to promote communication, co-operation and co-ordinated advance planning among the various national ministries and departments, and private and international development agencies.

6.5 Financing Heritage Conservation

To provide and channel much-needed additional funds for preservation and development of archaeological sites, a National Fund should be established to pool national and international income and donations according to the relevant Jordanian regulations for this purpose.

Additional financial resources are needed for funding restoration, preservation and development of archaeological sites. Receipts from visitor admissions at the sites should be reallocated to Antiquities.

7 INFORMATION SOURCES

7.1 Noteworthy Publications:

Jordan Department of Antiquities Publications

a) The Annual of the Department of Antiquities of Jordan (ADAJ). V1-V34. 1951-1990. Amman, Jordan.

The first volume of ADAJ was published in 1951, and it has appeared annually since. ADAJ consists of interim reports on the annual archaeological excavations in Jordan. An index of authors and sites was published in 1986.

b) The Department of Antiquities has published to date a series of three volumes entitled Studies in the History and Archaeology of Jordan. The fourth volume is in preparation.

Vol. 1: General Studies in the History and Archaeology of Jordan. Edited by Adnan Hadidi. 1982. Amman.

Vol. 2: Jordanian Environment: Geographical and Historical. Edited by Adnan Hadidi. 1985. Amman.

Vol. 3: Trade, Communications and International Relations to the End of the Ottoman Period. Edited by Adnan Hadidi. 1987. Amman.

Vol. 4: Settlement Patterns in Jordan. (In preparation)

c) Specific publications about the work and achievements of the Department of Antiquities.

Publications of the Yarmouk University Institute of Archaeology and Anthropology

a) The Newsletter of the Institute of Archaeology and Anthropology. NO.1-9. 1986-1990. Irbid, Jordan.

Published bi-annually to report the work and achievements of the Institute; seven issues have appeared to date.

b) The publication series of the Institute.

Newsletters

- Friends of Archaeology Newsletter
- Ancient Jordan Newsletter
- ACOR Newsletter

Books and publications on traditional architecture and sites in Jordan.

- Ahmad, Abdullah A. (1989). "Cultural Resources" (Chapter 6) in *Jordan Environmental Profile-Status and Abatement*. Amman, Jordan.
- IUCN-U'NEP-WWF. (1991). *Caring for the Earth, A Strategy for Sustainable Living*. Gland, Switzerland and Nairobi, Kenya.
- Rafa'i, Talib and Ruba Kana'an (1982). *Buyut Amman el-Ulla*. Amman.
- Royal Scientific Society. (1990). *Traditional Architecture in Jordan, Vol. 1, Salt*. Amman.

7.2 Topographic and Planning Maps

- Royal Jordanian Geographic Centre. (P.O. Box 20214. Amman-Jordan. Tel: 845188). Topographic maps at various scales. Also airphotographs and satellite imagery. Potentially the best source of maps in Jordan, but in practice the security restrictions limit access and use.
- Natural Resources Authority, Ministry of Energy and Mineral Resources. (P.O. Box 7. Amman-Jordan. Tel: 811300). Geographical maps of Jordan.
- Department of Antiquities, Archives and Registration Centre. (P.O. Box 88. Amman-Jordan. Tel: 644336 - 641275). General Maps, 1:250,000 1:100,000 1:50,000 1:25,000.

Maps with the important archaeological sites (the Department of Antiquities and the Royal Jordanian Geographic Centre). Maps of archaeological sites, plans.

- Small-scale topographic and climatic atlases.
- Ministry of Tourism and Antiquities. (P.O. Box 224. Amman-Jordan. Tel: 642311). New small-scale maps @ 1:750,000 with archaeological sites.

ANNEX 1 – INFORMATION ON WORKING GROUP

A-1.1 Membership of the Committees

Mr. Nasri Atalla	Chairman, Secretary-General, Ministry of Tourism
Mr. Faisal Al-Qudha	Dept. of Antiquities, Ministry of Tourism and Antiquities
Mr. Husni Hamdan	Dept. of Environment, MMRA&E
Mr. Azmi Khamis	Ministry of Information and Culture
Mr. Tareq Masarweh	Municipality of Greater Amman
Mr. Abdul Majid Arabiyat	Aqaba Region Authority
Dr. Safwan Tell	University of Jordan
Dr. Mujahid Muheisen	Yarmouk University
Dr. Jacques Seigne	IFAPO
Dr. Bert de Vries	ACOR
Mr. Ghazi Saudi	Friends of Archaeology

Dr. Mujahid Muheisen was named secretary of the working group that consisted of:

Dr. Ghazi Bisheh	Dept. of Antiquities, Ministry of Tourism and Antiquities
Dr. Mujahid Muheisen	Yarmouk University
Ms. Laurice Ehlass	Tourism, Ministry of Tourism and Antiquities
Mr. Husni Hamdan	Dept. of Environment, MMRA&E
Ms. Sahar Mansour	Dept. of Environment, MMRA&E
Mr. Azmi Khamis	Ministry of Information and Culture
Mr. Jamil Jaber	Tourism, Ministry of Tourism and Antiquities
Mr. Shehadeh Aze	Tourism, Ministry of Tourism and Antiquities
Dr. Safwan Tell	University of Jordan
Dr. Bert de Vries	ACOR
Ms. Ruba Kana'an	ACOR
Dr. Jacques Seigne	IFAPO
Mr. Ghazi Saudi	Friends of Archaeology

The sub-committee preparing the report:

Dr. Mujahid Muheisen	Yarmouk University
Mr. Hufzi Haddad	Department of Antiquities
Dr. Bert de Vries	ACOR
Ms. Ruba Kana'an	ACOR
Dr. Jacques Seigne	IFAPO
Mr. Ghazi Saudi	Friends of Archaeology
Ms. Suhelr Hadidi	Ministry of Information and Culture

A-1.2 List of On-call Members

Department of Antiquities, Ministry of Tourism and Antiquities (P.O. Box 88. Amman-Jordan. Tel: 644336 - 641275):

- Dr. Ghazi Bisheh
- Dr. Fawzi Zayadin
- Mr. Hufzi Haddad
- Mr. Ibrahim Haj Hasan
- Mr. Abdul Sami' Abu Dayyeh
- Mrs. Hanan Kurdi
- Mrs. Khawla Qussous
- Ms. Muna Zaghloul
- Dr. Khairieh 'Amr
- Dr. Wa'el er-Rashdan
- Dr. Mohammad Najjar
- Dr. Khaled Abu Ghonimeh
- Mr. Emseitef Suleiman

Tourism, Ministry of Tourism and Antiquities (P.O.Box 224. Amman-Jordan. Tel: 642311):

- Mr. Nasri Atalla
- Ms. Laurice Ehlass
- Mr. Jamil Jaber

Central Bank of Jordan Museum (P.O. Box 37. Amman-Jordan. Tel: 630301):

- Ms. Zahida Safar

Aqaba Region Authority (P.O. Box 21. Aqaba-Jordan. Tel: 03-314200):

- Mr. Abdul Majid Arabiyyat

Archaeology Department, University of Jordan (University of Jordan. Amman-Jordan. Tel: 843555):

- Dr. Safwan Tell
- Dr. Kheir Yassin
- Dr. Lutfi Khalil
- Dr. Nabil el-Kheiry
- Dr. Abdul Jalil 'Amr
- Dr. Sabri el-'Abadi

Institute of Archaeology and Anthropology, Yarmouk University (P.O. Box 566. Irbid-Jordan. Tel: 02-271100):

- Dr. Mu'awiyah Ibrahim
- Dr. Mujahid Muheisen
- Dr. Zeidan Kafafi
- Dr. Cherie Lenzen
- Dr. Saleh Sari
- Dr. Zeidoun el-Muheisen
- Dr. Khalaf Tarawneh
- Dr. Fawaz el-Khreishah
- Dr. Rifat Hazim
- Dr. Sataney Shami
- Dr. Fadwa Qirresh

Culture, Ministry of Culture

- Ms. Suhair Hadidi

ANNEX 2 – KEY INFORMATION SOURCES

A-2.1 Technical and Lay Informed Persons

<i>Name and subject of interest</i>	<i>Organization</i>
Dr. Ghazi Bisheh (Islamic Art and Architecture)	Director General of the Department of Antiquities
Dr. Mu'awiyah Ibrahim (Prehistory)	Institute of Anthropology and Archaeology, Yarmouk Univ.
Dr. Amr Haddad (Classical Archaeology)	National University
Dr. Fawzi Zayadin (Nabatean Archaeology)	Technical Assistant Director, Department of Antiquities
Dr. Assim el-Barghouti (Classical Archaeology)	King Sa'ud University, Riyadh
Dr. Kheir Yassin (Iron Age)	Archaeology Department, University of Jordan
Dr. Safwan Tell (Islamic Art and Architecture)	Archaeology Department, University of Jordan
Dr. Nabil el-Kheiry (Nabatean Archaeology)	Archaeology Department, University of Jordan
Dr. Sabri el-'Abadi (Ancient Inscriptions)	Archaeology Department, University of Jordan
Dr. Mahmoud Abu Talib (Akkadian Language and Writing)	Archaeology Department, University of Jordan
Dr. Zahida Safar (Nabatean Art)	Jordan Central Bank Museum Curator
Dr. Mujahid Muheisen (Prehistory)	Institute of Archaeology and Anthropology, Yarmouk Univ.
Dr. Lutfi Khalil (Ancient Metallurgy)	Archaeology Department, University of Jordan
Dr. Zeidan Kafafi (Neolithic Period)	Institute of Archaeology and Anthropology, Yarmouk Univ.
Dr. Mohammad Najjar (Bronze Age Pottery)	Excavation Section, Department of Antiquities
Dr. Khairieh 'Amr (Analysis of Pottery Raw Materials)	Archaeological Researcher, Department of Antiquities
Dr. Wa'el er-Rashdan (Islamic Archaeology)	Islamic Archaeology Section, Department of Antiquities
Dr. Khaled Abu Ghanimeh (Prehistory)	Department of Antiquities
Dr. Khalaf Tarawneh (Islamic Coins)	National Museum, Department of Antiquities
Dr. Fawaz el-Khreishah (Semitic Inscriptions)	Institute of Archaeology and Anthropology, Yarmouk Univ.
Mr. Hufzi Haddad (Restoration)	Department of Antiquities

Ms. Ruba Kana'an (Vernacular Architecture)	Cultural Resource Management Programme, ACOR
Ms. Leen Fakhoury (Architectural Conservation)	Department of Architecture, University of Jordan
Mr. Ammar Khammash (Conservation of Traditional Architecture)	Ministry of Tourism and Antiquities
Rami G. Khouri (Author, publisher)	Al Kutba, Publishers

ANNEX 3 – PROFESSIONAL ARCHAEOLOGISTS IN THE DEPARTMENT OF ANTIQUITIES, JORDAN

Dr. Ghazi Bisheh	Director General of the Dept. of Antiquities
Dr. Adnan Hadidi	National University, Former Director of Antiquities
Dr. Fawzi Zayadin	Technical Assistant Director
Mr. Feisal el-Qudha	Administrative Assistant Director
Mr. Hufzi Haddad	Head of the Preservation and Restoration Section
Dr. Hussein Qandil	Inspector, museum curator
Ms. Nazmieh Rida	Head of the Cultural Relations Section
Mr. Ibrahim Haj Hassan	Head of the Laboratory Section
Mr. Ahmed Odeh	Museum curator
Mr. Sultan Shreideh	Head of the Irbid Department of Antiq. office
Mr. Ali al-Sa'idi	Museum curator, Salt
Mr. Abdul Sami' Abu Dayyeh	Inspector of Greater Amman
Ms. Hanan el-Kurdi	Head of the Archives Section
Ms. Siham Balqar	Curator, Museum of Jordan Antiquities
Mr. Musa ez-Zayyat	Director, Museum of Jordan Antiquities
Mr. Ali Saleh	Inspector of Jerash
Mr. Sami er-Rabadi	Inspector of Ajloun
Mr. Hazem Ibrahim	Inspector of Madaba, Madaba Museum curator
Mr. Nabil Bqa'in	Inspector of Karak
Ms. Muna Zaghloul	Head of the Periodicals and Publications Section
Dr. Zahida Safar	Jordan Central Bank Museum curator
Ms. Khawla Qusous	Head of the Registration Section
Ms. A'ida Mohammad Amin	Jerash Museum curator
Mr. Mohamad Rsheidat	Inspector of Um Qeis, museum curator
Dr. Khairieh 'Amr	Archaeological researcher
Dr. Wa'el er-Rashdan	Head of the Islamic Archaeology Section
Dr. Mohammad Najjar	Head of Excavation Section
Dr. Khalaf Tarawneh	Coin specialist, Museum of Jordan Antiquities
Dr. Khaled Abu Ghanimeh	Prehistory specialist

Mr. Tayseer Ateyyat	Inspector
Mr. Ghassan er-Ramahi	Inspector of Madaba
Mr. Sa'ad Hadidi	Inspector of Salt
Mr. Emseitef Emseitef	Assistant inspector of Greater Amman
Mr. Musa Smadi	Inspector of Jerash
Mr. Nyazi esh-Shab'an	Inspector of Petra
Mr. Suleiman Farajat	Inspector of Petra
Ms. Qamar Fakhouri	Registration Centre
Mr. Hakem Mahamid	Inspector of Karak
Mr. Khaled el-Jbour	Inspector of Mafraq
Mr. Ibrahim Al-Zu'bi	Inspector of Ramtha
Mr. Mohamed Abu 'Ebeileh	Inspector of Ajloun
Mr. Wajih Karasneh	Um Qeis Museum curator
Ms. Iman 'Uweis	Jerash Museum curator
Ms. Hanan Azar	Archives
Ms. Rula Qusous	Registration and Research
Ms. Rawia Nabil	Antiquities Librarian
Ms. Iman el-Qudha	Folklore Museum curator
Ms. Nuha el-'Absi	Folklore Museum assistant curator

ANNEX 4 – LIST OF GOVERNMENT AND NON-GOVERNMENT AGENCIES

A-4.1 Government Agencies

- a) Ministry of Tourism and Antiquities, Department of Antiquities, and its regional offices
(P.O. Box 88. Amman-Jordan. Tel: 644336 - 641275)
(P.O. Box 224. Amman-Jordan. Tel: 642311)
- b) Ministry of Information and Culture
(P.O. Box 6140. Amman-Jordan. Tel: 636391)
- c) Natural Resources Authority, Ministry of Energy and Mineral Resources
(P.O. Box 7. Amman-Jordan. Tel: 811300)
- d) University of Jordan Arts Faculty
(University of Jordan. Amman-Jordan. Tel: 843555)
Department of Archaeology
Department of Geography
Department of Human Studies
Engineering Faculty
Department of Architecture
- e) Yarmouk University
(P.O. Box 566. Irbid-Jordan. Tel: 02-271100)
Institute of Archaeology and Anthropology
Jordan Studies Centre
- f) Royal Jordanian Geographic Centre
(P.O. Box 20214. Amman-Jordan. Tel: 845188)
- g) Royal Scientific Society
(P.O. Box 925819. Amman-Jordan. Tel: 844701)

Non-government Agencies

- a) Royal Society for the Conservation of Nature
(P.O. Box 6354. Amman-Jordan. Tel: 811689)
- b) Friends of Archaeology Society
(P.O. Box 2440. Amman-Jordan. Tel: 659987)
- c) Friends of the Museum, Yarmouk University, Irbid
(P.O. Box 566. Irbid-Jordan. Tel: 02-271100)
- d) Petra National Trust
(P.O. Box 312. Amman, Jordan. Telex 21323. Tel: 659978)
- e) ACOR, the American Centre of Oriental Research
(P.O. Box 2476. Amman-Jordan. Tel: 846117)
- f) IFAPO, Institut Francais d'Archeologie du Proche Orient
(P.O. Box 374. Amman-Jordan. Tel: 611872)
- g) BIAAH, British Institute at Amman for Archaeology and History
(P.O. Box 952071. Amman-Jordan. Tel: 841317)
- h) German Protestant Institute for Archaeology
(P.O. Box 183. Amman-Jordan. Tel: 842924)
- i) Foreign archaeological missions through their cultural attaches.

ANNEX 5 – ARCHAEOLOGICAL PROJECTS AND NAMES OF DIRECTORS (1980–1991)

Name of Project and Director

Abila
(Dr. W. Harold Mare)

Abu Snessle
(Suzanne Kerner)

Amman Citadel
(Dr. Rudolph Dornemann)

Amman Citadel, Ajloun - Kifranja Survey
(Dr. Joseph Greene)

Aqaba-Ayla
(Dr. Donald Whitcomb)

Azraq
(Douglas Baird and Andrew Garrard)

Bab Dhra, Feifa, Wadi Khneizir
(Dr. Walter Rast, Dr. R. Thomas Schaub)

Basta
(H.J. Nissen and Mujahed Muheisen)

Da'jania, Qasr Bshir, Lejjun
(Dr. Thomas Parker)

Deir Ain Abata
(Konstantine Politis)

Lehun
(Denyse Homes-Fredericq)

Humayma
(Dr. John Oleson)

Iraq Dub
(Ian Kuijt)

Jordan Valley survey, Khirbet Khilda
(Dr. James Sauer)

Katarat Samra
(Dr. Albert Leonard)

Karak, Shohak and Quweira Castles
(Ms. Robin Brown)

Khirbet Kursi
(Abdul Jalil Amr)

Khirbet Faris
(Jeremy Johns and Allison McQuitty)

Khirbet Iskander
(Dr. Suzanne Richard)

Moab Survey
(Prof. J. Maxwell Miller)

Name of Project and Director

Qanawat Firaum
(Thomas Weber)

Qasr Burqu
(Alison Betts)

Southern Jordan Deforestation Survey
(Patricia Fall)

Teleilat Ghasul
(Peta Seaton)

Tell Abu Hamid
(Zeidan Kafafi and Genevieve Dollfus)

Tell Abu Khreis
(Peter Fischer)

Tell Abu Sarbut
(Edward Lagroa)

Tell Hamam
(Kay Prag)

Tell Umeiri, Tell Hesban
(Dr. Lawrence Geraty)

Tell Sa'idiyeh
(Jonathan Tubb)

Tell Hajjat
(Mr. Steve Falconer and Dr. Bonnie Magness)

Tell Iktanu
(Kay Prag)

Tell Maqass
(Lutfi Khalil)

Tell Nimrin
(Dr. David McCreery and
Prof. James Flanagan)

Temple of Hercules, Amman
(Mohammed Najjar)

Temple of Zeus, Jerash
(Jacques Seigne)

Tor Um Dni
(Kenneth Russell)

Umayyad Palace, Amman
(Antonio Almagro)

Um Jimal
(Dr. Bert de Vries)

Um Walid
(Jacques Bujard)

North Jordan Arabic Inscriptions Survey
(Fredericq Imbert)**Numeira**
(Michael Coogan)**Pella**
(Robert Smith)
(Basil Hennessy and Alan Walmsley)**Petra**
(Dr. Philip Hammond)**Petra**
(Rolf Stucky)**Petra Cult Niches**
(Ms. Marie-Jeanne Roche)**Petra-Aqaba Roman Road Survey**
(David Graf)**Qaa Disi-Wadi Rum**
(Edoardo Borzatti)**Qweismeh Church**
(Dr. Robert Schick)**Roman Roads**
(Dr. David Graf)**Um Rasas**
(Jacques Bujard)**Um Qeis**
(Peter Bol, Thomas Weber and
Adolf Hoffmann)**Wadi Qattar, Abu Alanda area**
(Khairiyah 'Amr and Mohammad Najjar)**Wadi Yabis**
(Dr. Gaetano Palumbo and Dr. Jon. Mabry)**Wadi Feidan**
(Russell Adams)**Wadi Hasa Palaeolithic project**
(Dr. Geoffrey Clark)**Wadi Hasa Survey, Wadi Araba Survey**
(Prof. Burton MacDonald)**Wadi Hisma**
(Dr. Don Henry)**Wadi Shuaib, Ain Ghazal**
(Gary Rollefson and Dr. Alan Simmons)**Yasilah**
(Zeidoun el-Muheisen)

12 • Legal Initiatives for the Strategy³⁵

Jordanian legislation is the subject of this chapter, in terms of its suitability and adequacy to deal with environmental protection and pollution control issues. Recommendations are made with respect to updating and developing environmental laws and regulations to improve management of Jordan's environment.

Laws and regulations pertaining to the environment, and their amendments and other modifications, often overlap and create confusion. Although some legislation is effective, it generally lacks analytical depth and supporting research.

1 EXISTING LEGISLATION

1.1 General Observation

Duplication among official agencies responsible for environmental matters has led to operational and managerial problems and a lack of focus in the national environmental protection programme. Specifically:

- There does not yet exist a National Environmental Law for protecting Jordan's environment, although one legislative initiative is under review in the prime minister's office.
- There is no formal co-ordinating mechanism, and little co-operation, among the different agencies involved with the environment.
- Consequently, no coherent national environmental programme has been developed which would utilize the considerable expertise available in Jordan.

1.2 Jordanian Laws Relating to the Environment

- Agriculture Law No. 20 of 1973.
- Antiquities Law No. 12 of 1976.
- Aqaba Region Authority Law No. 7 of 1987.
- Crafts and Industries Law No. 16 of 1953 and related regulations.
- Electricity Authority Law No. 8 of 1976.
- Jordan Valley Authority Law No. 18 of 1977.
- Marine Establishment of Aqaba Port Law No. 4 of 1969.
- Municipalities Law No. 29 of 1955.
- Nuclear Energy & Radiation Protection Law No. 14 of 1987.
- Organization of Cities, Villages and Buildings Law No. 79 of 1966 and regulations.
- Organization of Natural Resources Affairs Law No. 12 of 1963.
- Public Health Law No. 21 of 1971.
- Punishments Law No. 16 of 1960.
- Quarries Law No. 8 of 1971.
- Traffic Law No. 14 of 1984.
- Water Authority Law No. 18 of 1988.

³⁵Information in this chapter was prepared by the Legal Committee, under the Chairmanship of Mr. Ma'moun Salah, Director of Legal Department, MMRA&E.

2 RECOMMENDATIONS OF WORKING GROUPS REGARDING LEGISLATION FOR EACH SECTOR

2.1 Agriculture and Lands

- Define dates, quantities and types of insecticides and control their residual levels in the soil.
- Control use of insecticides and verify their specifications before use.
- Establish an efficient monitoring staff to verify how and when insecticides are used.

2.2 Surface and Groundwater

- Issue appropriate legislation to conserve water resources, protect watersheds and control water depletion.
- Revise and unify environmental legislation and define which agencies are responsible for implementation and follow-up.
- Define the mechanism for enforcing laws.
- Where warranted, enact water management legislation appropriate to local conditions.
- Enact legislation enabling municipalities to compel citizens to build water wells.

2.3 Wildlife and Habitat

- Current legislation fails to mention the establishment and management of nature reserves and national parks.
- Current legislation fails to mention fauna and flora, marine life, and protection of coral reefs.
- It is imperative that an environmental protection law be formulated for Jordan.
- Regulations must be devised governing the rehabilitation of quarries after their use, including afforestation.

2.4 Coastal and Marine Life

As legislation dealing with environmental management of this sector is insufficient, a law should be introduced to deal with all environmental issues in coastal and marine areas, including conservation of marine life. A law will be needed to create a new marine national park.

2.5 Energy and Mineral Resources

Make appropriate institutional and legislative changes.

2.6 Population and Human Settlements

- Issue legislation authorizing local councils to conserve the natural and human environment and natural resources within their jurisdictions.
- Issue legislation stipulating the revision and updating of zoning ordinances every ten years.
- Establish institutional linkages between agencies working in various fields of environmental protection and management, and create a Central Environmental Agency.
- Within each agency involved in environmental protection, establish a division to follow up the implementation of regulations and laws.

2.7 Atmosphere and Air Quality

- A unified law for the "Protection of the Environment" should be enacted, including a section on atmospheric and air-quality protection, and defining the responsible implementing agencies.
- Review existing laws and regulations dealing with air and atmospheric pollutants which are repetitive, contradictory and inadequate.

2.8 Antiquities and Cultural Resources

Legislative inadequacies include:

- Lack of a special law governing land use, to protect archaeological sites.
- Undefined responsibility of landowners for antiquities located on their lands.
- Inadequately implemented antiquities law which lacks punitive deterrence.

3 PROPOSED ACTIONS AND RECOMMENDATIONS

3.1 Environmental Legislation

Introduce special environmental legislation that would:

- Define and broadly address all issues relating to the environment.
- Assign responsibility for implementing the law to those administrative agencies authorized to manage natural resources, so that duplication and overlap are avoided.
- Add and define appropriate penalties for environmental crimes.

Annul all existing laws and regulations that contradict the proposed legislation.

3.2 Institutional Framework

Create an independent institutional framework for managing environmental affairs. Within this framework an agency would be established to:

- Formulate a national environmental policy that would address all sectors of the environment.
- Define comprehensive bases for the environmental framework.

3.3 Advice on Environmental Legislation³⁶

a) Seek advice from other countries that can offer experience in framing and drafting appropriate environmental legislation.

b) It may also be necessary to conclude agreements between the Hashemite Kingdom of Jordan and neighbouring countries such as Saudi Arabia and Syria in order to better organize and utilize energy resources, and to protect the environment.

³⁶*Advice on Environmental Legislation (International)*. The best source of information on conservation and environment law is The Environmental Law Programme, IUCN-The World Conservation Union, Adenauerallee 214, D-53 Bonn-1, Germany. (Information available on the IUCN Commission on Environmental Law and the Environmental Law Centre).

ANNEX 1 - INFORMATION ON WORKING GROUP

A-1.1 Current Members of Working Group

<i>Name</i>	<i>Organization</i>
Mr. Ma'moun Salah Director of Legal Dept., MMRA&E Chairman of the Committee	Ministry of Municipal, Rural Affairs & the Environment
Miss Iman Muqbel Legal Consultant; Rapporteur	Ministry of Health
Dr. Saleh Sharari Legal Consultant	Department of Environment, Liaison Officer
Mr. Hisham Tell Legal Consultant	Ministry of Water and Irrigation, and the Aqaba Region Authority
Mr. Jamil Jaber Legal Consultant	Ministry of Tourism and Antiquities
Mr. Hussein Jaber Legal Consultant	Municipality of Greater Amman
Mr. Ibrahim Bazbazat Legal Consultant	Ministry of Energy and Mineral Resources
Dr. Ali Khattar	Faculty of Law, University of Jordan

Drafting committee:

Mr. Ma'moun Salah
Miss Iman Muqbel
Dr. Saleh Sharari
Mr. Hussein Jaber
Mr. Jamil Jaber
Mr. Ibrahim Bazbazat